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S·A·E Journal

FEBRUARY 1940

THE SOCIETY OF AUTOMOTIVE ENGINEERS ·

Speed Nut System

WE'RE WAITING FOR THAT ASSEMBLY PROBLEM

Thanks for looking, thanks for listening and thanks for your interest in SPEED NUTS and SPEED CLIPS at the Detroit Convention.

But—some of you have not yet sent in those assembly problems that you spoke about. We are all busy, of course, but it will take you only a minute to drop us a note. Once we have a sample of the actual parts as now fastened, we can quickly determine the proper SPEED NUT application that will do the job FASTER, BETTER and AT LOWER COST. You have a lot to gain and nothing to lose by shooting it in right now while it's fresh in your mind.

Speed Nuts

TINNERMAN PRODUCTS, INC.

2063 Fulton Road - - - Cleveland, Ohio.

MANUFACTURERS OF PATENTED SPEED NUTS

• In Canada: Wallace Barnes Co. Ltd., Hamilton, Ont. • In England: Simmonds Aerocessories, Ltd., London

900 MILLION SPEED NUTS ALREADY USED

S·A·E JOURNAL

Published Monthly By The Society of Automotive Engineers, Inc.

Arthur Nutt, President — David Beecroft, Treasurer
John A. C. Warner, Secretary and General Manager
Norman G. Shidle, Executive Editor

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About Authors

● *After graduating from Cornell University as a mechanical engineer with the Class of '24,* **A. J. Blackwood** *(M '27) spent three years on the engineering faculty instructing in the experimental testing laboratories. He later joined the research staff of Mack Trucks, and had a part in the development of their first six-cylinder truck and bus engines. After two years with Mack he went with what is now the Standard Oil Development Co., and at present is in charge of the engine laboratories and the testing and development of automotive, diesel, and aviation fuel. He has presented a number of papers before the Society.*

● **H. Blok** *was born in Amsterdam and before entering college had five years of preliminary training in the Netherland East Indies. He returned to Amsterdam for his diploma and entered the Technical University at Delft, Holland, from which he was graduated as mechanical engineer in 1932. He continued at the University for another year, studying electrical engineering, and then joined the technical staff of Royal Dutch Shell's Delft Engine Laboratory. He specialized on lubrication under extreme conditions and has published several papers on the subject. Together with G. D. Boerlage he developed the Four-Ball Top, the Four-Ball Machine, and the Planetary Gear Machine for the study of lubrication under boundary and extreme-pressure conditions. At the Delft Laboratory he is in charge of boundary lubrication research.*

● **G. H. Cloud** *(M '38), after graduating from the University of Buffalo in 1935 with the degree of Ph.D. in physical chemistry immediately started working for the Standard Oil Development Co. in the Fuels Division. His work has been devoted to diesel-fuel studies correlating physical and chemical properties with ignition and combustion in the engine, and to correlating laboratory and road-test results on diesel fuels. Since 1937 he has been in charge of the Esso Laboratories' diesel-fuels research work.*

● **D. A. Wallace** *(M '19) was born on a ranch in Kansas. Starting out as a*

(Concluded on page 54)

Publication Office, 56th and Chestnut Sts., Philadelphia, Pa.; Editorial and Advertising Departments at the headquarters of the Society, 29 West 39th St., New York, N. Y. Western Advertising Office, Room 2-136 General Motors Bldg., Detroit, Mich.

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Again

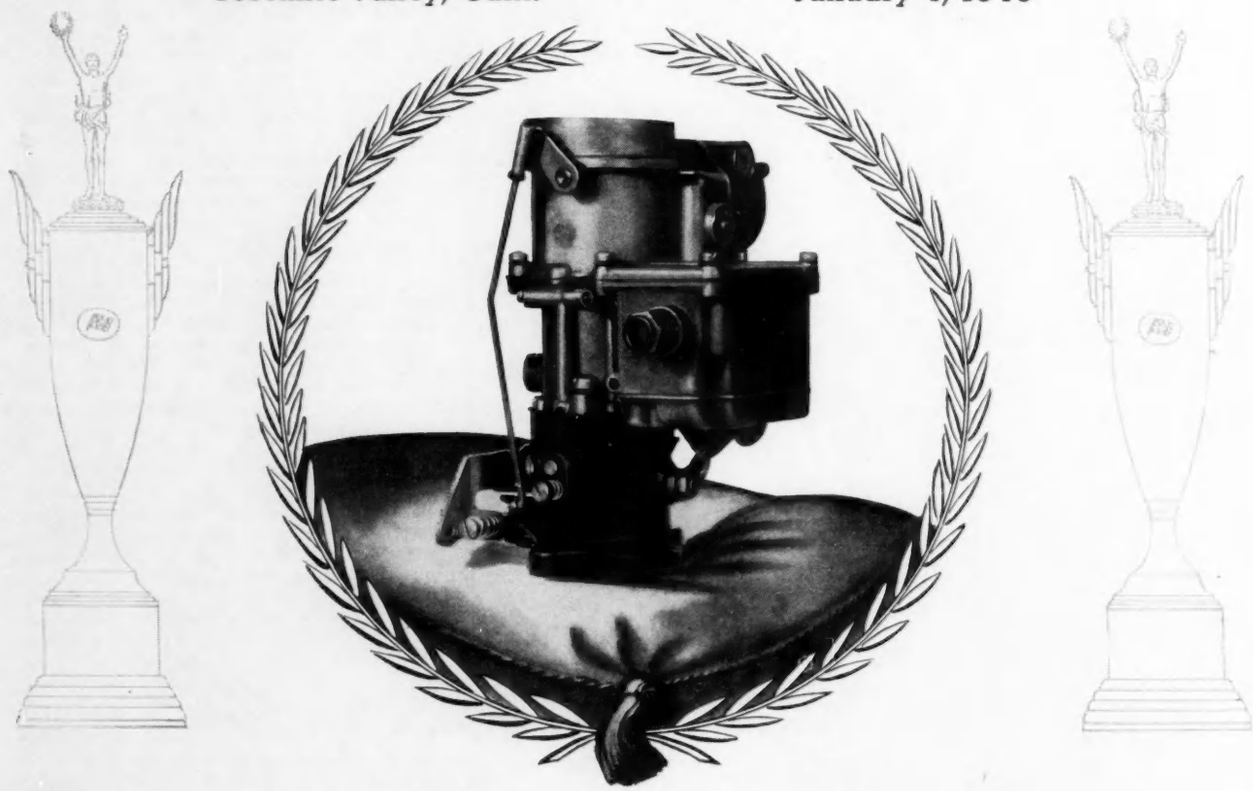
STROMBERG CARBURETORS

Take FIRST *and* SECOND *places*

in the annual

Gilmore Economy Sweepstakes!

Yosemite Valley, Calif. *January 4, 1940*



PRECISELY as they did in 1939, Stromberg-equipped cars again in 1940 carried away top honors in this well-known AAA-supervised economy contest!

The Studebaker Commander and President, in winning these well-deserved new laurels for themselves, demonstrated anew the thrifty efficiency of Stromberg Carburetion.

To automotive engineers, to automotive service specialists and to automobile owners, these added certifications simply re-verify the known facts about Stromberg performance.

STROMBERG CARBURETORS

Product of BENDIX PRODUCTS DIVISION OF BENDIX AVIATION CORPORATION, South Bend, Indiana

Sharp Technical Debates Mark 35th Annual Meeting

ENGINEERS from all branches of the automotive industry – more than 2500 of them – poured into the Book-Cadillac in Detroit for the 35th Annual Meeting of the Society of Automotive Engineers, Jan. 15-19 . . . . . and new data-backed ideas poured from speakers and discussers at every session. Cars, trucks, aircraft, diesels, fuels and lubricants – every phase of the great industry growing out of the internal-combustion engine – was probed. Fresh concepts sprouted all along the line. Debate greeted every idea, new or old, with some of the aircraft and aircraft-engine discussions reaching new highs in frankness and value.

Passenger-car men heard, among other things, that one of last year's top-flight technical headaches, varnish in engines, is not as acute now; that the style and character of upholstery chosen for car seats has a definite effect on riding comfort; that car manufacturers will probably agree on a set of temperature ranges for the recommendation of seasonal changes for transmission and rear-axle lubricants so their customers will not be confused from year to year; that "plastic fenders and a molded body still remain as the greatest prospective field for extension of the uses of plastics in the automobile."

Opinions at aircraft sessions included one that an up-to-date 4-stroke aircraft diesel could compete on a basis of parity with 87-octane gasoline aircraft engine; another that there is no difference in power and efficiency between the alkylated form of safety fuel and gasoline; another that the mica-insulated spark plug has reached the limit of its development in types suitable for high-output aircraft engines; another that aircraft performance can be accurately predicted from wind-tunnel tests only when the power, propeller efficiency and drag used in the calculations are the same as those obtained in flight; and another that it is impractical to provide enough vertical tail area in an airplane to control the airplane by allowing a certain angle of yaw without depending upon the pilot to apply the proper amount of rudder.

Different speakers brought out that the octane number of fuel required to operate 1939 automobiles without knock is slightly higher than that found for 1938 cars; that the filtering system is the link in the injection equipment set-up for oil engines which determines the limit of the viscosity of the fuel used; that another "safety" fuel can now be made available in very substantial quantities and that the price will depend upon the specifications finally decided upon; that better smoke control of diesels can be obtained by use of lighter fuels and suitable ignition quality, but not without some loss in power and fuel economy; and that future ventilating systems in passenger cars will probably be better than today's best.

New Facts Plentiful

Throughout 21 sessions facts were piled up, conclusions were drawn from research and experience data, and detailed information was revealed bearing on every element of design, operation, and production. Following pages tell the full story of each of these vital technical sessions.

The opening of the meeting brought a record-breaking first-day attendance, successful inauguration of the $2 registration fee for non-members, intense interest in the 1940-model SAE Engineering Display and a junior-student session in the evening at which C. E. Weitz, General Electric Institute, brought striking demonstrations of recent developments in light and lighting to a large audience.

The Business Session was held on Tuesday evening. Following announcement of the election of 1940 SAE officers, President W. J. Davidson presented President-elect Arthur Nutt who spoke briefly in appreciation of the honor which had been given him.

A Life Membership in the Society was presented to Harry T. Woolson, who was president of the Society in 1937.

A special feature was added to the announced Tuesday program when many SAE members got a much clearer picture of events behind

THE DOOR IS OPENED

BIRTH of a SESSION

FRIEND MEETS FRIEND

early World War advances of the German Army, and its later defeat, brought to them by Major M. V. Brunson, Quartermaster Corps, U. S. Army, at an "added-attraction" session following the Truck, Bus & Railcar Session, Tuesday afternoon.

Major Brunson gave a wealth of background material leading up to the pre-war plans of both the German and French Governments, depicted influences which affected the actual carrying out of the plans, and showed tactical errors made by both sides. His talk was illustrated with diagrams of battles and pictures of the German Army during its invasion of Belgium and Northern France.

PASSENGER-CAR SESSIONS

Chairmen

J. C. Zeder **J. G. Wood**

R. M. Critchfield

Cooling as well as improved heating and ventilating of automobiles is definitely on its way, prominent passenger-car engineers agreed at one of three sessions sponsored by the Passenger-Car Activity. The details of seat-cushion design were revealed in new perspective in relation to riding comfort at the same session, while importance of educating the public in the proper use of both headlights and direction signals was stressed at another session which dealt with these two subjects. That varnish in engines is no longer as acute a problem as it was a year or so ago was indicated by data gathered from almost every major producer and presented at the first of these sessions. A penetrating analysis of the existing situation in regard to rear-axle and transmission lubricants was another high spot.

The varnish and lubricants papers were presented at the first of the Passenger-Car Sessions.

Recent Opinions on Varnish in Engines – **F. F. KISHLINE, Nash Motors Division, Nash-Kelvinator Corp.**

IN this paper, a sequel to the one he presented at the 1939 Annual Meeting, Mr. Kishline sees portrayed "a clearer understanding of the matter and less confusion with extraneous problems." As before, Mr. Kishline's paper compiled information and experiences contributed by anonymous members on the subject of varnish and sludge formation. A questionnaire was prepared and sent to 18 manufacturers, Mr. Kishline explained. The 16 questions asked with the 18 replies to each question comprised the bulk of his presentation.

In general, the answers to the various questions indicated:

1. That varnish or lacquer formation in engines is not, or is no longer, a serious problem. Several contributors reported that formation had been eliminated or reduced by changing to another grade of oil or fuel, or installing oil coolers.

2. That sludge causes more trouble than varnish, especially in diesel engines. Only three contributors reported no sludge problems; five thought varnish more troublesome. Temperature control and crankcase ventilation are recommended to overcome the difficulty.

3. That operating temperatures tie up with these troubles, sludge forming with low temperatures and varnish forming with high temperatures.

4. That oil-change recommendations have not been revised on account of the sludge and varnish problem, except to suit extreme operating conditions.

5. That, by working on these problems with various oil companies, grade or viscosity changes have been made to improve these conditions and that, in general, certain grades of oil materially reduce the deposits. The alignment on this subject, however, was closer, with a greater percentage dissenting.

6. That compounded oils materially reduce or eliminate varnish or sludge deposits.

7. That opinion is about equally divided as to whether or not filters help. The waste-packed type filter was believed to be the most beneficial by more contributors than was any other type.

8. That a thorough flushing, cleaning, and refilling with the proper oil is the best way to recondition a sludged or varnished engine for resumption of service. A number also recommended installing new piston rings.

9. That, if cleaning does not remove all engine deposits, the length of service before the trouble recurs is shortened.

10. That the oil industry and the automotive industry should cooperate in solving the varnish and sludge problem, but that the oil industry is in a position to be of greater help.

In the latter part of his paper Mr. Kishline quoted excerpts from an SAE paper by F. L. Miller, J. F. Kunc, Jr., and R. W. Richardson, Standard Oil Development Co., that had an important bearing on the subject.

In summary Mr. Kishline declared that the opinions seemed to indi-

cate that some engines will varnish with any oil and some oils will varnish in any engine. He suggested that a standard method of test for varnish and sludge would be of great assistance to both automotive engineers and refiners.

Discussion

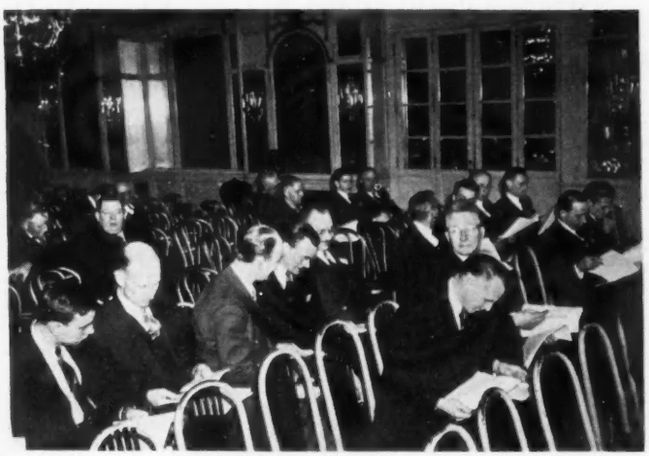
After expressing his belief that Mr. Kishline's paper evidenced progress in the solution and a better understanding of the varnish and sludge problems, H. C. Mougey, General Motors Corp., predicted that by summer at least half a dozen oil companies will come out with oils developed to inhibit varnish and sludge.

Axle and Transmission Lubrication – **W. S. JAMES, Studebaker Corp.**

THE majority of car manufacturers recommended to their customers two or more seasonal changes of axle and transmission lubricants on 1931 to 1940 cars, Mr. James reported. He also noted a slow increase in the number recommending a single all-season lubricant and that the use of three and four seasonal changes now has disappeared.

Answering the question: "Why do not the manufacturers agree on a set of temperature ranges for the recommendation of seasonal changes for transmission and for rear-axle lubricants or both, so that their customers will not be confused from year to year?" he assured his listeners that they would do so just as they have done in the case of temperature ranges for motor oils.

Speaking of hypoid gear lubrication he said: "The development of a mechanism like the hypoid gear is like exporting goods to a fast-developing country. If the climate of the country is hot and torrid, refrigerating machinery should be exported, not furnaces. If the people are of a high-pressure and fast-moving type, they will want telephones, radios, cars." He then announced that his paper was an attempt to describe the "foreign lands" of transmissions and rear axles so that the



EARLY BIRDS GET SEATED

"goods" most suitable to the "climate and people" of these "countries" can be shipped them. Emphasizing the importance of the temperatures, pressures, and rubbing speeds encountered in rear-axle and transmission gearing, he said that they are probably the most important factors in the selection of suitable lubricants.

In the considerable data presented, he gave test results on present-day types of test machines for three of the current types of hypoid lubricants.

Discussion

An answer to Mr. James' question: "Can the laboratory test reproduce the characteristic type of hypoid gear tooth surfaces as reproduced in the Chrysler test?" came from Ernest Wooler, Bower Roller Bearing Co., in the form of "Definitely it can," but the test equipment must be a high-class mechanism for accurate results. Reading from prepared discussion Mr. Wooler then described the Gleason axle testing machine used by his laboratory. He explained that this test machine can be used not only for delicate oil tests and other tests originally attempted on the four-square machine, but for breakdown, preload, and deflection tests under correct specifications.

The load we are interested in, he pointed out, is the load on the coast in forward – the load imposed every time that the foot is lifted from the accelerator pedal – when coasting against the motor. He then reported a test on a 1940 production spiral-bevel axle in which the ring-gear deflection at the pinion mesh was 60% more with the load on the coast side of the tooth in forward than with the load on the coast side of the tooth in reverse.

He described other tests in which he had duplicated the results of the Slider differential tests submitted at the EP Lubricants Committee meeting last year by E. W. Upham of Chrysler, and also confirmed these same findings at high speeds and low loads. He reported that these tests show definitely that the active-sulphur lubricants, not only scuff, but still show considerable bearing wear.

In conclusion, Mr. Wooler stressed the importance of workmanship and the art of gear cutting, the knowledge of deflections which will change the tooth contact, and maintenance of rigidity, in preventing failure. Eventually, he believes, we will be able to get the axle down in size, bring the hypoid pinion down to the same size as the corresponding spiral-bevel pinion, and reduce the size of the ring gear, and deflections will be reduced automatically.

By means of a curve flashed on the screen, C. M. Larson, Sinclair Refining Co., pointed out that the ideal all-purpose hypoid lubricant must have "Dr. Jekyll and Mr. Hyde" characteristics. It showed that the lead-active sulphur type of lubricant has excellent high-speed or anti-weld properties but is limited in anti-friction characteristics; that the non-corrosive truck lubricant has superior anti-friction properties but poor anti-weld characteristics. The ideal all-purpose hypoid lubricant must be superior in both respects, Mr. Larson concluded.

Seat Cushions and the Ride Problem – **CLYDE R. PATON, EDWIN C. PICKARD and VINCENT H. HOEHN, Packard Motor Car Co.**
(Presented by Mr. Paton)

CUSHION studies should be an integral part of the ride development problem, these authors contended, pointing out that the trim engineer, as a part of the body engineering department, has never had much chance to appraise the ride phase of his problem. They brought much evidence to show that proper balance between the car suspension and the passenger suspension, namely, the trimmed seat, should have a very definite relationship. They showed clearly the effect of seat pads, upholstery cloth and style, and seat contours as well as of seat springs on riding comfort and presented the results of tests indicating the effect on ride of different combinations of these elements.

One of the most important functions of the pad, they said, lies in its

(*Continued on page 35*)

THE SESSION'S ON

Collective Bargaining Here to Stay, Nutt Urges SAE Expansion

FEATURE event of the 35th Annual Meeting was the dinner on Thursday evening at which W. L. Batt, president, SKF Industries, Inc., was the principal speaker and at which Arthur Nutt, vice-president, Wright Aeronautical Corp., was introduced to SAE members as their president for 1940.

George Delaney, Detroit Section Chairman, presided as chairman, and introduced C. C. Carlton, vice-president, Motor Wheel Corp., as toastmaster. W. J. Davidson, retiring 1939 SAE president, spoke briefly in appreciation of the combined efforts of the many members and committeemen which had been so effective during his administration, mentioned the successful World Automotive Engineering Congress as an important SAE achievement during the last year, and stressed the alertness of the Society to its responsibilities in connection with National preparedness.

'Expand Research and Standards,' Nutt Proposes

"Research and Standardization, two of the more important activities for which the Society has been well known for many years, should be expanded," Mr. Nutt said in his inaugural address which was devoted to an outline of SAE needs and opportunities. He urged further thought on methods of presenting standards to make them even more useful to the members and to the industry.

Stressing the inadequacy of current funds to carry on work as extended as desirable, he urged that serious thought be given to the acceptance of endowments by the Society as is done by universities and other educational units.

He urged that every possible encouragement be given to SAE Journal advertising, asked the personal cooperation of members in sending information about jobs to the SAE Placement Department, and pointed to the possibilities of increasing the membership of the Society two or threefold.

The SAE, Mr. Nutt said, gives the engineer a chance to develop himself and become better known in his profession – and to meet other men in his own profession, to write and present technical papers and to participate in the Society's affairs. "He can participate in both local and National affairs through committee work, through official positions and through technical papers," Mr. Nutt pointed out, "with the result that at least in his chosen field he will soon need no introduction anywhere."

Concluding, he urged members to take advantage of the benefits of the Society by participating in its activities, by offering their services and by obtaining new members.

'Business Can Save Free Enterprise' – Batt

Mr. Batt, who within the last week had been made chairman of the Business Advisory Council for the U. S. Department of Commerce and chosen chairman of the board of directors of the American Management Association, stated frankly that, in his opinion, collective bargaining, as a guaranteed right of labor, is here to stay. He hopes that the Wagner Act will be modified and that the policies of the National Labor Relations Board will be reconstituted, but he is definitely of the opinion that the Wagner Act will not be repealed.

How fast unionism as the force to implement the collective bargaining principle for labor, is to grow, will be considerably influenced by our attitude as employers, Mr. Batt believes. "If we do for labor all that can wisely be done – if we treat labor as a force to be fairly reckoned with in the disposition of the customer's dollar – if we convince labor that no outsider can have that real consideration for his welfare that the employer can, and demonstrate that intent in a human way, then the labor organizer will have his work cut out for him," Mr. Batt said, adding emphatically:

"But the employee will have to be convinced that we honestly agree with his right to bargain collectively, his right to belong to a union if he wants to. When he believes that *is*

C. C. Carlton

Batt Tells Annual Meeting Dinner; and Additional Financing

the policy of his employer, I have faith that eventually he will insist on his fellow workmen and himself acting squarely in return."

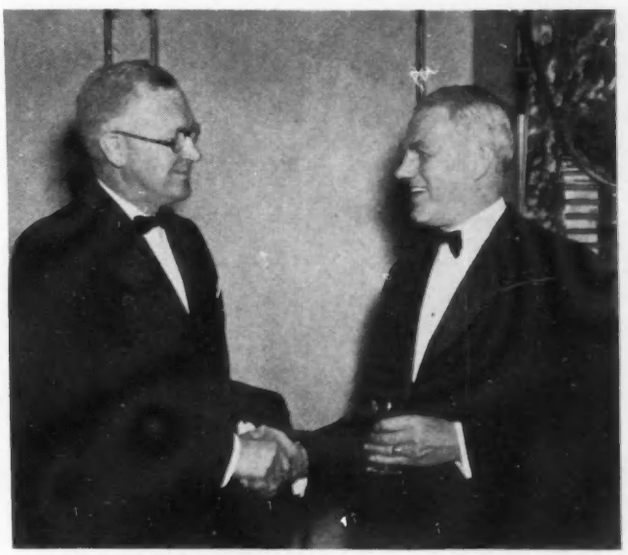
Hitting straight from the shoulder, Mr. Batt said:

"By and large the American workman is nobody's fool; he can be misled for a while, but in the long run, he can be depended upon to come to a sound conclusion. He will come to that conclusion, however, by the persuasion of fairness, by patient example, by tolerance and mediation – *not by legislation and not by force.*"

Mr. Batt sees the pendulum swinging still further in the direction of security for labor. "To the extent that this is not provided voluntarily by private enterprise," he said, "it is likely to be provided by legislation or judicial interpretation." The courts today are showing a willingness to recognize the proprietary interest of labor in its job, he said, pointing out that this is a new conception of property rights the implications of which are far-reaching. "It may well be," he said, "that management is actually preserving the fundamental principle of private property if it does everything it can to see that as many people as possible have more property of their own; not alone buildings and ground, but automobiles and radios and *jobs.*"

Developing this thought further, Mr. Batt said: " 'This is my machine – my bench – my desk' imply some measure of pride and possession and, if the element of responsibility can be tied to holding the job, I am not too much concerned over this new concept of property right. But so that no one shall construe this as a justification for such excesses by labor as Detroit has seen, let me point out that the possession of a property right does not mean its uncontrolled use. Try to burn your own house, use your own automobile to the danger of your neighbor, leave your own mangy dog to die by the road, and see what society does to you!"

W. L. Batt



W. J. Davidson Arthur Nutt

The attitude of the public, Mr. Batt stressed, will exert continuously greater pressure on the direction of labor relations. It will determine the attitude of local law-enforcement agencies and, in the long run, the trend of state and National legislation.

He pointed out that this determination of the public to assert its interest cuts both ways. The loss of confidence in business in recent years came about, he believes, because the man in the street felt that business had let him down. "And, if this man in the street gets the idea that our criticism of the Wagner Act, the Wages and Hours Act, and similar legislation, is for our own selfish interest and so we can be freer to take advantage of labor," Mr. Batt emphasized, "then we can be prepared for legislation far more stringent than anything we have seen so far."

Specifying unemployment as one of the big problems of management, Mr. Batt stressed the fact that the manufacturing industry is not as much at fault here as most people think. In September 1929, he showed, it employed 11,367,000 people, and in September 1937, 11,308,000 – only 59,000 less.

Mr. Batt believes that something worth while can be accom-

plished in regularization of employment if each management will look at its own business and see what it can do to provide more regular work. "One thing we can all do," he said, "is to be more reasonable in our planning and purchasing requirements as they affect suppliers." In any case, Mr. Batt said, "the extent to which more regularized employment is provided will be a direct measure of labor's satisfaction with its job." He concluded: "I am not nearly so much concerned with the menace of the 'isms' or with the Browders and the Kuhns as with the certain reactions of men out of work. Because it is our No. 1 danger, it is our No. 1 job.

"Business alone can save the private property system and check the trend toward totalitarianism," Mr. Batt concluded.

"It must shift from a defense to an aggressive offense," he said. "For its regular habit of attacking Government, it can make more friends by turning toward its own self-improvement, toward talking about and doing those things which the public will like.

"For us as management to hold such views doesn't mean we're turning pink or selling out; it only means that we are determined to have the leadership which belongs to us; to win back whatever public confidence we may have lost; to show the American people that its greatest good lies down the road of private enterprise and not down the road of more and more control by Government. To no group of business leaders can this appeal be more persuasive than to the men who make up the automotive industry . . . these men are made out of too heroic stuff to admit failure in these newer problems of management which have more to do with methods than materials, more with men than machines."

SAE *Coming* EVENTS

March 14-15 — **National Aeronautic Meeting**
Washington Hotel – Washington, D. C.

•

March 28-29 — **National Transportation & Maintenance Meeting**
Mellon Institute Auditorium – Pittsburgh, Pa.

•

June 9-14 — **Summer Meeting**
The Greenbrier – White Sulphur Springs, W. Va.

•

Baltimore – Feb. 8

Engineers Club; dinner 6:30 p.m. Permanent Mold Casting and Its Relation to the Automotive Industry – Edward C. Hoenicke, sales manager, Eaton Erb Foundry Division, Eaton Mfg. Co.

Buffalo – Feb. 13

Hotel Statler; dinner 6:30 p.m.

Canadian – Feb. 21

Royal York Hotel; dinner 6:30 p.m.

Chicago – Feb. 6

Chicago Towers Club; dinner 6:30 p.m. Fuel Rating – Its Relation to Engine Performance – A. M. Rothrock, senior physicist, National Advisory Committee for Aeronautics.

What's Going On in the Air – Arthur Nutt, vice-president of engineering, Wright Aeronautical Corp., and president of the SAE. Guest – John A. C. Warner, general manager of the SAE.

Cleveland – Feb. 12

Cleveland Club; dinner 6:30 p.m.

Detroit – Feb. 5 and 26

Statler Hotel. Feb. 5 – dinner 7:00 p.m. Photoelasticity as Applied to Design Problems – T. V. Buckwalter, vice-president, Timken Roller Bearing Co.

Feb. 26 – no dinner; meeting 8:00 p.m. Military Use of Airplanes.

Indiana – Feb. 9

Antlers Hotel; dinner 6:30 p.m. What's Going On in the Air – Arthur Nutt, vice-president of engineering, Wright Aeronautical Corp., and president of the SAE. Sealed-Beam Headlighting – engineer from Guide Lamp Division, General Motors Corp. Guest – John A. C. Warner, general manager of the SAE.

Kansas City – Feb. 7

Hotel Continental; dinner 6:30 p.m. What's Going On in the Air – Arthur Nutt, vice-president of engineering, Wright Aeronautical Corp., and president of the SAE. Guest – John A. C. Warner, general manager of the SAE.

Metropolitan – Feb. 15

Hotel New Yorker, New York City; dinner 6:30 p.m. The Automotive Diesel Engine – Charles E. Lucke, Stevens professor of mechanical engineering, Columbia University. Diesels at Work – W. J. Cumming, general superintendent, Surface Transportation Corp. of N. Y.

Milwaukee – Feb. 5

Milwaukee Athletic Club; dinner 6:30 p.m. What's Going On in the Air – Arthur Nutt, vice-president of engineering, Wright Aeronautical Corp., and president of the SAE. Proper Application of SAE Steels – John Mitchell, manager Alloy Bureau, Metallurgical Division, Carnegie-Illinois Steel Corp.

New England – Feb. 13

Engineers Club, Boston. Speaker – A. T. Colwell, vice-president, Thompson Products, Inc.

Northern California – Feb. 3

Fairmont Hotel, San Francisco; dinner 6:30 p.m. Annual Dinner Dance.

Northwest – Feb. 9

Forty and Eight Club, Seattle, Wash.; dinner 6:30 p.m. Air Brake Developments – Past, Present and Future – V. Villette, vice-president, Westinghouse Pacific Coast Brake Co.

Oregon – Feb. 9

Portland. Report on Annual Meeting of the Society – J. Verne Savage, Chairman Oregon Section, SAE, and superintendent, City of Portland Municipal Shops.

Philadelphia – Feb. 14

The Penn Athletic Club; dinner 6:30 p.m.

Pittsburgh – Feb. 23

Webster Hall; dinner 6:30 p.m. Annual Ladies' Night.

St. Louis – Feb. 8

Hotel Coronado; dinner 6:30 p.m. What's Going On in the Air – Arthur Nutt, vice-president of engineering, Wright Aeronautical Corp., and president of the SAE. Guest – John A. C. Warner, general manager of the SAE.

Southern California – Feb. 9 and 16

Feb. 9 – Elks Temple, Los Angeles; dinner 6:30 p.m. Design, Operation and Maintenance of Diesel Locomotives and Steam Turbine Locomotives – H. V. Gill, supervisor of Diesel engines, Santa Fe Railroad. This subject will also be discussed by an engineer from the Union Pacific Railroad.

Feb. 16 – Masonic Temple, Glendale, Calif.; dinner 6:30 p.m. Cabin Supercharging – David Gregg, research engineer, Eclipse Aviation Division, Bendix Aviation Corp.

Syracuse – No Meeting

Southern New England – Feb. 7

Bond Hotel, Hartford, Conn. Valves for High Duty Engines – A. T. Colwell, vice-president, Thompson Products, Inc.

Tulsa Group – Feb. 2

Hydraulic Drives in Industrial Service – R. M. Schaefer, manager, Hydraulic Dept., Twin Disc Clutch Co.

Washington – Feb. 13

Cosmos Club, Washington, D. C.; dinner 6:30 p.m.

ARTHUR NUTT
SAE President *for* 1940

ARTHUR NUTT, newly-elected president of the Society of Automotive Engineers, is one of the world's outstanding engineering authorities on aircraft engines – both air and liquid cooled. During his 23½ years of continuous service with the Curtiss-Wright Corp. and its predecessors, he has participated in the development of, or been responsible for the development of many of the renowned powerplants with which American and World aviation history has been written. He is today the vice-president for engineering of the Wright Aeronautical Corp. at Paterson, N. J.

Mr. Nutt, the son of Charles and Ada S. Nutt, was born at New Rochelle, N. Y., on Feb. 6, 1895. In 1899, his parents and family, which included two brothers and three sisters, moved to Worcester, Mass., where Mr. Nutt's father took over the managing editorship of the *Worcester Spy,* a daily newspaper established in 1776, the year the Colonies declared their independence. It was most appropriate that Charles Nutt should be selected to guide a publication so steeped in tradition, as no less than 16 of his ancestors had fought in the Revolutionary War – a fact that has made Arthur Nutt a life member of the Sons of the American Revolution.

After attending the public schools of Worcester, from which he was graduated in 1908, and the Classical High School of the same city from which he was graduated in 1912 as Senior Class President, Mr. Nutt entered Worcester Polytechnic Institute. He was graduated in 1916 with the degree of Bachelor of Science in Mechanical Engineering. He did not, however, wait until he obtained his degree to obtain practical experience. All during the summers of 1913, 1914, and 1915 he worked as a mechanic for the Crorker Garage at Falmouth, Mass.

In college, his scholastic average was high, and he was chosen while in college for membership by Tau Beta Pi, and in 1929 by Sigma Xi.

Immediately after graduation he went to work in the assembly department of Curtiss Aeroplane & Motor Co. at Buffalo, N. Y., at a salary of $15 a week. One of his first jobs was the assembling of fittings on the famous Curtiss "Jenny" wings. Mr. Nutt also participated in the development of the Curtiss Model T Flying Boat built by Curtiss for the British Admiralty.

Mr. Nutt was transferred to the experimental motor department of the concern as a test observer on July 29, 1916, and as is evident from his rapid rise, almost immediately began to display those characteristics which have brought him to his present position. After advancing to test engineer in charge of a night crew, he was promoted in 1919 to motor engineer, reporting directly to the chief motor engineer. In 1920, four years after his graduation from Worcester, he was appointed chief motor engineer of the Curtiss company in charge of engine development.

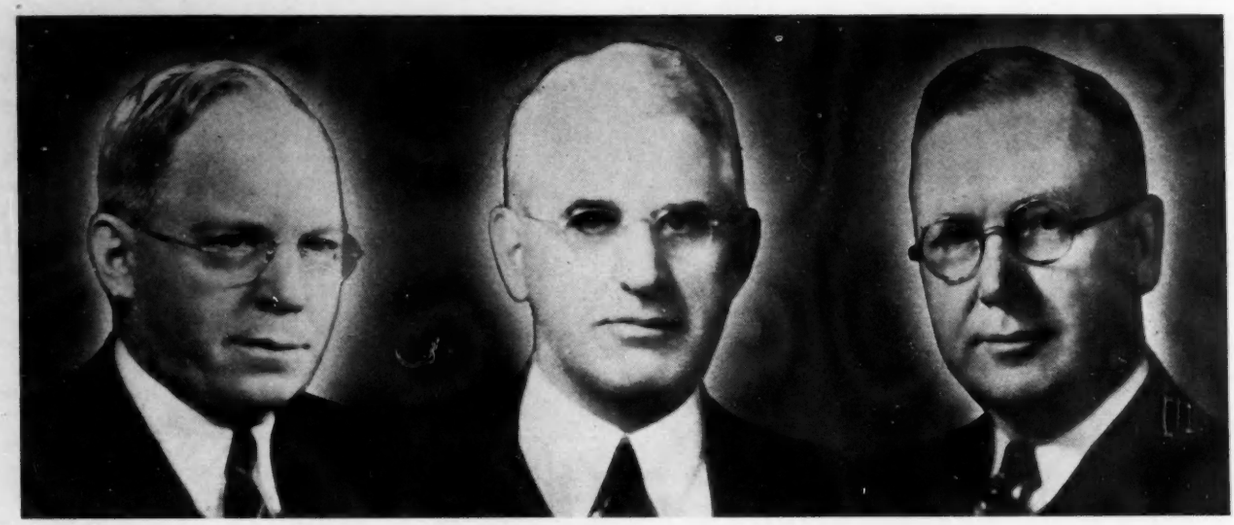
In 1929, the various Curtiss units were merged with Wright Aeronautical Corp. to form the present Curtiss-Wright Corp. As a result of this merger, Wright Aeronautical, on April 30, 1930, selected Mr. Nutt as vice-president for engineering. Shortly afterward, the Curtiss motor division was moved to Paterson, N. J., and consolidated with the Wright company manufacturing and engineering facilities.

During the decade 1930-1939, Mr. Nutt has directed the engineering policies of the Wright Aeronautical Corp. and the development of Wright aircraft engines.

As the result of his wide travels and contacts, he is known wherever airplanes fly. He is a private pilot of 15 years standing and maintains his license on an active basis. He has visited every aircraft factory in the country and has traveled extensively in 20 countries of Europe and Asia.

He has been a member of the SAE since 1922, and twice has been vice-president of the Society representing its Aircraft-Engine Activity. For several years Mr. Nutt has been chairman of the aircraft-engine division of the SAE Standards Committee, of which he has been a member since 1926. He also holds membership on the Standards and Research Committees of the Society and has taken a leading part in the work of several of their divisions. Since 1936 he has been the SAE representative on the Engineering & Industrial Division of the National Research Council.

Mr. Nutt is a licensed professional engineer in the States of New Jersey and New York; a member of the Montclair Society of Engineers; chairman of the CFR Aviation Fuels Division of the CFR Committee; a member of the Institute of Aeronautical Sciences, of which he was a member of the Council from 1935 through 1939; a member of two subcommittees of the National Advisory Committee for Aeronautics; a member of the National Aeronautic Association; and a life member of the Sons of the American Revolution.



Harry T. Woolson, president of the SAE in 1937, continues on the Council as past-president

David Beecroft will serve his eighth consecutive term as treasurer of the Society

W. J. Davidson, 1939 president of the Society, becomes a member of the 1940 Council as past-president

Councilors

SERVING on the Council during 1940 and 1941 will be AUSTIN M. WOLF (M '11), who previously was a Councilor in 1935 and 1936. Mr. Wolf has been director of standards in the Division of Standards and Purchase of the State of New York for a number of years, and recently was, in addition, appointed acting deputy commissioner of the division. Mr. Wolf also practices as an automotive consultant, and is well known to SAE members for articles analyzing new car trends which appeared in the SAE Journal from 1926 until 1938, which he discontinued writing because of increasing demands upon his time. He is also the author of numerous papers delivered before the Society and the Sections. In 1911, at the time Mr. Wolf joined the Society, he was draftsman for the Interboro Rapid Transit Co., New York. He entered the automotive industry in 1912 with the Twombly Motors Corp., and in 1914 became designing engineer for the former General Vehicle Co. After serving as chief engineer for several companies, he embarked in 1928 on a career as consulting engineer, which he has continued to date. Mr. Wolf has served as secretary and twice as chairman of the Metropolitan Section, on the National Transportation & Maintenance Activity Committee, the Meetings Committee, the Publications Committee, and on several SAE Research and Standards Committees, including the Motor Truck Rating Committee, and recently was appointed chairman of the National Membership Committee. He also is SAE representative on, and chairman of, the Highway Traffic Standards Committee of the American Standards Association, and an alternate representative on the ASA Mechanical Standards Committee and the ASA Standards Council.

JAMES B. FISHER (M '17), vice-president of the Waukesha Motor Co., returns to the SAE Council for a two-year term; previously having been a Councilor in 1934-1935. Mr. Fisher has been engaged in various lines of engineering work for the past 35 years, the last 24 with the Waukesha Motor Co. He was advanced from mechanical engineer to chief engineer of Waukesha in 1923, and elected to the post of vice-president in 1937. Prior to joining Waukesha he had been affiliated with the Federal Bridge Co. and the Alliance Machine Co. Mr. Fisher's SAE activity began in 1919 when he became a member of the Gasoline Engine Division of the Standards Committee. He has continued on that division, serving as its chairman in 1922-1923, and as vice-chairman in 1926 and from 1930 to date. He also has served as chairman of the Crankcase Oil Stability Research Committee from 1934 to date, and has held membership on the Lubricants Division of the Standards Committee since 1925, the General Research Committee, the Ignition Research Committee, the Tractor and Industrial Power Equipment Activity Committee (as vice-chairman in 1939), and the Motorcoach and Motor Truck Division of the Standards Committee.

MURRAY FAHNESTOCK (M '21), who begins a two-year term as a member of the SAE Council, is editor of *Ford Field*. He has been engaged in writing for automotive publications since completing his studies in electrical and mechanical engineering at Carnegie Institute of Technology in 1911, with the exception of part of one year when he was lecturer at the University of Pittsburgh. He began his editorial work as technical editor of *Motorcycling Magazine* in 1912. Then he worked for the Ford Motor Co. From 1919 to date, Mr. Fahnestock has been with his present company. After serving for many years as technical editor of *Ford Dealer & Service Field*, he advanced to the editorship in 1937. Last year, the publication shortened its name to *Ford Field*. Mr. Fahnestock was chairman of the Pittsburgh Section in 1934 and had earlier served as vice-chairman and treasurer. He was the Section's representative on the National Sections Committee from 1931 to 1932 and from 1936 to 1938. Last year he served on this committee as a member-at-large. He also served on the Meetings Committee as a member-at-large in 1935.

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W. E. MCGRAW, chief engineer of Chrysler Corp. of Canada, Ltd.; GEORGE L. NEELY, research engineer in charge of fuels and lubricants, Standard Oil Co. of Calif.; and ALMON L. BEALL, research engineer, Wright Aeronautical Corp., will continue on the Council, completing two-year terms to which they were elected last year.

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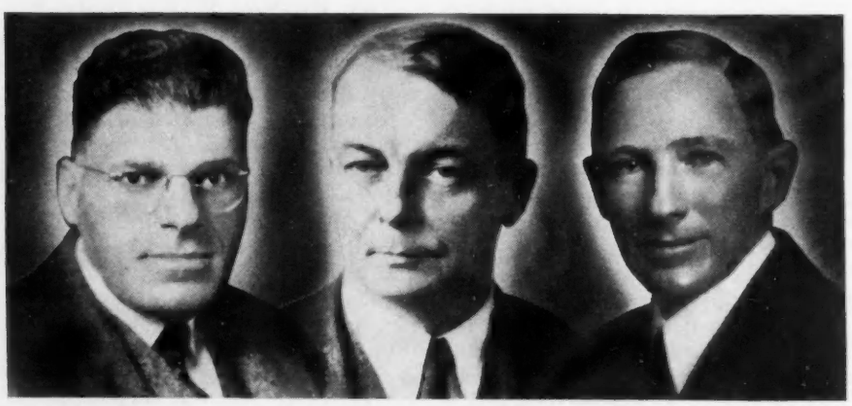


Austin M. Wolf

James B. Fisher

Murray Fahnestock

Vice-Presidents

G. W. Laurie (M '35), who takes office as vice-president representing the Transportation and Maintenance Engineering Activity, was educated as a mining engineer and was engaged in mining work from 1914 until 1926, except for two years in the United States Army during the War. In 1926 he entered the employ of the Atlantic Refining Co. and was placed in charge of construction equipment, maintenance of measuring and recording instruments, maintenance of refinery equipment, and refinery transportation. His experience with automotive equipment began with the motorization of the company's teaming department, and in 1933 he was assigned to the task of reorganizing the operation of the entire Atlantic truck and passenger car fleet. His present title is manager of automotive transportation. Mr. Laurie has served as a member of the SAE Transportation and Maintenance Committee, the Motor Truck Rating Committee, the Transportation Division of the Standards Committee, and as Philadelphia Section Representative on the National Meetings Committee.

Norman N. Tilley (M '22), who recently resigned his position as chief engineer, Detroit Plant, Continental Motors Corp., to join the engineering staff of the Lycoming Division of Aviation Mfg. Corp., heads the Aircraft-Engine Engineering Activity as vice-president for 1940. After graduating in mechanical engineering from Cornell University in 1915, Mr. Tilley continued at Cornell until 1918, first as instructor in experimental mechanical engineering, and later as U. S. Army Air Service instructor on aviation engines. He remained in the Air Service until 1920, as flying cadet and later as airplane pilot and engineer officer in charge of various training courses at Kelley Field. During the next two years he taught mechanical engineering at the New Mexico A. & M. College and the University of Texas. In 1922 he joined the Engineering Division of the Air Service. He advanced from test engineer to mechanical engineer, chief, engine specification and development unit of powerplant branch, Materiel Division, U. S. Army Air Corps, at Wright Field, in 1929. In that year he became chief engineer of the Kinner Airplane & Motor Corp., remaining in that capacity until 1931, when he was placed in charge of engineering of the American Airplane & Engine Corp., engine department. In 1932 he joined the engineering department of Continental. Mr. Tilley has been active in the SAE committee work since 1930 and has held membership on the Aircraft-Engine Activity Committee; the Aircraft-Engine Division of the Standards Committee, of which he was vice-chairman in 1938 and 1939; the Fuels Subcommittee of the Research Committee; the Cooperative Fuel Research Steering Committee; and the Membership Committee.

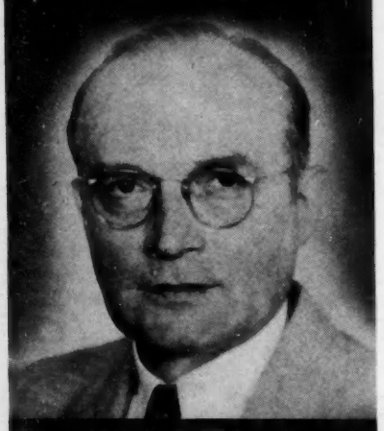
Serving as vice-president representing Aircraft Engineering is Stephen J. Zand (M '28), consulting engineer, Sperry Gyroscope Co., Inc. Mr. Zand was born in Poland, and received his technical education at the Federal Polytechnical School, Zurich, Switzerland, and Ecole Superieure d'Aeronautique, Paris. After the War he was draftsman with Hispano-Suiza and later assistant research engineer with Citroen, before coming to the United States as designer for Pierce-Arrow in 1925. After four months with that company Mr. Zand turned to aviation and held positions as aeronautical engineer first with Curtiss Aeroplane & Motor Co., then with Ford, Taylor Instrument Co., and the Pioneer Instrument Co., Division of Bendix Aviation, before affiliating with the Sperry Gyroscope Co. in 1932. In that year he received the Wright Brothers Medal for his paper on instrument board vibrations presented at the 1931 SAE National Aeronautic Meeting. Mr. Zand has been active on numerous SAE committees, serving at various times as chairman of the Wright Brothers Medal Board of Award, and as a member of the Riding Comfort Subcommittee of the Research Committee, the Aircraft Activity Committee, and as SAE Representative on the Sectional Committee of Acoustical Measurements and Terminology, functioning under the procedure of the American Standards Association. He also is author of several papers presented before meetings of the Society. He is a Fellow of the Institute of the Aero Sciences and Associate Fellow of the Royal Aeronautical Society.

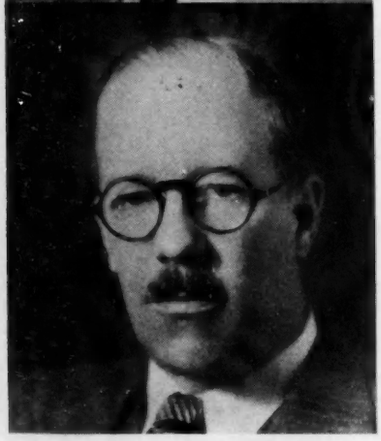
John Oswald (M '38), who heads body engineering at the Olds Motor Works Division of General Motors Corp., is vice-president representing the Passenger-Car-Body Engineering Activity. When in his teens Mr. Oswald spent his summer vacation periods in the drafting rooms of the Columbus Buggy Co., and the United States Carriage Co. World War service interrupted his studies, and after being mustered out he continued his education by studying courses offered by Alexander Hamilton Institute, Andrew F. Johnson, the Washington School of Arts and others. From 1918 until 1922 he was chief body engineer with the Emil Body Co., and for the next two years held the same position with the Phillip Body Co. He joined the Auburn Automobile Co. as chief designer in 1925, and continued in that capacity until going with Olds as chief body engineer in 1929.

Almon L. Beall W. E. McGraw George L. Neely

G. W. Laurie
Norman N. Tilley
Stephen J. Zand
John Oswald

B. Frank Jones C. G. A. Rosen James C. Zeder





J. M. Davies

Edwin R. Smith

Neil MacCoull

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B. Frank Jones (M '30), 1940 vice-president representing the Truck, Bus and Railcar Engineering Activity, is chief engineer, truck division, of the White Motor Co. He entered the automotive industry in 1918 as assistant flying-boat production engineer with the Curtiss Aeroplane & Motor Co. He transferred to motor-truck engineering in the following year and began his long affiliation with the truck division of the Pierce-Arrow Motor Car Co., which in 1934 was merged with the White Motor Co. Mr. Jones continued with White, serving as engineer of its Public Works Division in 1937 and as chief engineer of its Indiana Truck Division in 1938. He was appointed to his present position last year. Besides holding membership on the Motorcoach & Motor Truck Division of the Standards Committee and the Truck, Bus and Railcar Activity Committee, Mr. Jones was chairman of the Cleveland Section in 1938, vice-chairman the previous year, and has been the Section's representative on the National Meetings and Sections Committees.

C. G. A. Rosen (M '37), vice-president representing Diesel-Engine Engineering Activity for 1940, is assistant chief engineer in charge of diesel research for the Caterpillar Tractor Co. Mr. Rosen served in machine shop, forge, foundry, and drafting room on oil-engine construction and repair after graduating from Cogswell Polytechnic College and the University of California with B.S. and M.E. degrees. He was diesel engineer and chief engineer with the Dow Pump and Diesel Engine Co. from 1915 until 1922, when he engaged in practice as consulting and research engineer. This practice covered design, construction, and maintenance of diesel engines and their installation for a broad clientele, including engine and equipment manufacturers, ship operators, powerplants, and government agencies. During his seven years as consultant he also was instructor in diesel engines for the University of California Extension Course, contributed to several motor-boat publications, and was author of one and co-author of another diesel-engine correspondence course. From 1929 to date he has been engaged in development of mobile diesel engines for the Caterpillar Tractor Co. Mr. Rosen has been an active member of the SAE Fuels and Lubricants Activity Committee since 1937, and of the Diesel-Engine Activity Committee since 1938. He also has served as a member of the Crankcase Oil Oiliness Research Committee during the past two years.

James C. Zeder (M '23), chief engineer, Chrysler Corp., is vice-president representing the Passenger Car Engineering Activity. Mr. Zeder received his B.S. from the University of Michigan with the Class of '22, and a Doctor of Engineering from the University of Dayton in '38. He served as service engineer for the Timken Roller Bearing Co. in 1923. Two years later he joined the Maxwell-Chrysler Motor Corp. as experimental engineer. In 1929 he was named chief engineer of the Plymouth and DeSoto Divisions; in 1931, assistant chief engineer of the Chrysler Motors Corp.; and 1937 advanced to his present position as Chrysler chief engineer. He has served as a member of the SAE Passenger-Car Body Activity Committee, the Highways Research Committee, and in 1939, as vice-chairman of the Passenger-Car Engineering Activity Committee.

THE 1940 vice-president representing the Tractor and Industrial Power Equipment Engineering Activity is J. M. Davies (M '30), research engineer, Caterpillar Tractor Co. After earning his B.S. degree at the University of California, Mr. Davies was employed as a layout draftsman with the Standard Oil Co. of Calif. While continuing his studies for an M.S. degree, which he received in 1925, he was employed by the Western States Gas Co. Immediately after completing his courses, Mr. Davies joined the Caterpillar Tractor Co. as experimental engineer. In 1928 he became chief experimental engineer in charge of the engineering laboratory. He was transferred from San Leandro, Calif., to Peoria, Ill., in 1933 as research engineer, and his headquarters continue in that city. Mr. Davies has been a member of the Tractor and Industrial Power Equipment Activity Committee since 1935, and last year served as its representative on the National Membership Committee. He also was appointed to membership on the Tractor and Equipment Division of the Standards Committee in 1936, and has continued as a member since that year.

Edwin R. Smith (M '12), who has been a member of the SAE Production Activity Committee and of the Production Division of the Standards Committee since 1935 and 1936 respectively, serves as vice-president representing Production Engineering. Mr. Smith is vice-president and general manager of the Seneca Falls Machine Co., with which he has been affiliated in that capacity for the past 17 years. After attending public schools, Mr. Smith gained his technical education by studying at home in connection with his early jobs as machinist draftsman with the Fitchburg Machine Works and in the engineering and production departments of the Saurer Motor Co. He was works manager and later general manager of the Seneca Falls Mfg. Co., and was secretary and works manager of Sargent & Greenleaf, Inc., prior to 1920 when he became president of the Auto-Mailing Machinery Co., the position he held until joining Seneca Falls Machine Co. in 1922.

Neil MacCoull (M '17) is vice-president heading the Fuels and Lubricants Engineering Activity. After receiving his M.E. degree from Columbia University in 1913, he immediately entered the automotive industry as mechanical engineer with a cycle car company. After that, he turned to writing and was associate editor of *Aerial Age Weekly* for a while, before he joined the Westinghouse Machine Co. as mechanical engineer in 1916. When this Country entered the War Mr. MacCoull went to France with the U. S. Naval Air Forces. Returning to business in 1919 he became automotive engineer for The Texas Co., and during his 20 years with this organization, he has carried out research investigations on the performance and applications of motor fuels and lubricants. He also has aided in the layout and operation of three mechanical research laboratories for The Texas Co., and now has the title of research engineer. In 1925 Mr. MacCoull was elected chairman of the Metropolitan Section. Since 1927 he continuously has been a member of the SAE Research Committee, and since 1929 a member of the Fuels Research Committee, which he headed that year. Mr. MacCoull's membership on the Fuels and Lubricants Activity Committee dates back to 1936, and more recently membership on the Aircraft Engine Lubricants Research Committee and the Crankcase Oil Stability Research Committee have been added to his SAE activities. Since 1915 Mr. MacCoull has presented 12 papers before SAE meetings.

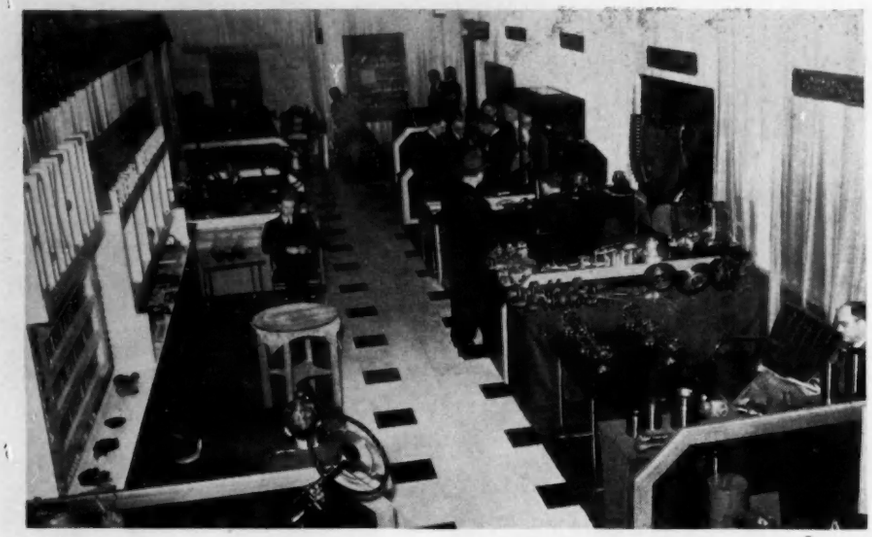
ENGINEERING . . . . DISPLAY

PLENTIFUL innovations as well as many long established products received well deserved attention by hundreds of members and guests who visited the Engineering Exhibit at the 1940 Annual Meeting, for a large proportion of these products are designed by and produced under the supervision of members of the Society, or find their chief sale to companies represented in the membership. There were 35 exhibits in all – and there were some highlights in every one.

ACHESON COLLOIDS CORP. had, as a feature of its display, colloidal graphite designed for use in volatile solvents which facilitate the coating and impregnation of various materials with this type of graphite. The same form of graphite is now used also in Bonderized parts and is said to increase the life of shock absorber pistons and similar parts subjected to friction. Laminated plastics for bearing and similar uses are now being impregnated with colloidal graphite prior to laminating, the exhibit indicated.

AIR REDUCTION SALES CO.'S exhibit centered around the gases which the company supplies in steel bottles for welding and other production and servicing work, flame hardening and the like, and included both flame hardening and welding equipment, nozzles and accessories. Also shown was this company's Wilson Hornet arc welder.

ALUMINUM CO. OF AMERICA had its usual fine showing of automotive parts made from aluminum and magnesium alloys and centered attention on a movie film showing how such products are fabricated by casting, rolling, extrusion, forging and other processes. Aluminum alloy bearings, for crankshafts running at low to moderate speed and for similar applications, were among new items. A wide variety of castings, including those made in sand molds,



CAMPBELL, WYANT & CANNON FOUNDRY CO.'S display included many examples of advanced practice of the ferrous foundry art and featured products in which tensile strength ranged from 30,000 to 90,000 lb per sq in. minimum. Crankshafts and camshafts, piston and cylinder castings, brake drums and other centrifugal castings, and several other castings were displayed to give some indication of how the foundry keeps up its end of modern quantity production with modern alloys.

CITIES SERVICE OIL CO. featured equipment for combustion studies on exhaust gases, including a new synchronizing device by which it is possible to collect the sample close to the exhaust port over as little as 2 deg of crankshaft travel – an important consideration especially on two-cycle diesels. Also displayed were a new solvent flushing liquid said to have high film strength, as well as good solvent properties; and a large cartridge type dispenser for greasing, convenient to load with assurance of dirt-free grease.

permanent molds and in dies were much in evidence. These included fine examples of pistons in Lo-Ex alloys and of die castings among which were some in magnesium alloys.

ALUMINUM INDUSTRIES, INC. showed many of the products which it fabricates from steel as well as from aluminum alloys – pistons and valves being among the most important. One of its newer products displayed is a seal for water pumps combining a brass retainer, a neoprene ring and a thrust washer cut from laminated bakelite. An aluminum sand-cast head for Plymouth engines, small connecting rods made in permanent molds and other castings were also displayed.

AMERICAN BOSCH CORP. divided its exhibit about equally among its automotive products, including several types of magnetos and of diesel fuel pumps and injection nozzles; a new final stage filter for diesel fuel; lighting generators and an electric windshield wiper. Fuel pumps shown included not only self-contained units but those designed for actuation by a cam on the engine camshaft.

AMERICAN HAMMERED PISTON RING DIVISION OF KOPPERS CO. displayed numerous types of piston rings some of which were of the "Gold Seal" type having bronze inserts. Another type featured was a thin cast-iron ring designed for aircraft engines and having the top and bottom surfaces lapped with thickness held, it was stated, within plus or minus 0.00025-in. limits.

BAKELITE CORP.'S exhibit gave emphasis to the numerous colors available in its phenolic, polystyrene, cellulose-acetate and urea plastics and to exhibits featuring certain significant properties of these plastics for automotive applications. In each of the latter – covering the headings: chemical stability, shock resistance, dimensional stability, resistance to heat and humidity, color stability and cold flow – the four types of plastics were rated in order of merit. Many good examples of plastic molding were shown, as was also a sheet of Vinylite plastic such as is now extensively used in safety glass.

BEE-LINE CO. displayed its machine "for static, dynamic and centrifugal balancing" of wheels, wheel hubs and wheel assemblies, including tires, and showed the accessory items required in balancing work. The machine has a vertical balancing spindle on which the wheel is mounted and is supplied with a balance meter and other accessories.

BRUSH DEVELOPMENT CO. focused its exhibit on an instrument termed a "Surface Analyzer" and designed to produce a graphical record showing the character and degree of roughness of the surface tested. The instrument has a stylus arranged to apply pressure on a rochelle salt crystal and thus produce an electrical potential impulse which is amplified and reconverted into mechanical motion of the recording pen.

CLEVELAND GRAPHITE BRONZE CO. again showed its versatility in producing bearings in which both cast and wrought metals as well as some which are sintered are employed either singly or in desirable combinations. A relatively new feature of this display was a steel-back bearing with babbitt coating only 0.003 to 0.005 in. thick. Clutch discs with sintered bronze-graphite facings and many types of bushings were among numerous items shown.

DeLUXE PRODUCTS CORP. focused attention on a display of its oil filters in which clean and dirty oil flowed over glass globes. After some 30 min filtering the dirty oil appeared to be as free from sediment as the clean oil. Also displayed were pistons of molybdenum-silicon steel, produced by Campbell,

Wyant & Cannon Foundry Co. and marketed by DeLuxe Products. These are cast in sections so thin as to rival aluminum alloy pistons closely in weight, it is claimed.

DIESEL EQUIPMENT CORP. had, as a feature of its display, different designs of diesel fuel injection valves, some of which, in the large sizes, are provided with a water jacket to maintain temperatures within desired limits. Also shown were a variety of precision aircraft parts, such as small gears and valve parts, which this company produces on a contract basis.

DOEHLER DIE CASTING CO. had a particularly impressive display of die castings not only in the most widely used zinc alloys, but in those based on aluminum, magnesium and copper (brass). Overall dimensions ranged up to 48 in. and parts having considerable areas of wall, some only 0.040 in. or less in thickness, received deserved attention. A central feature of the exhibit was a group of radiator grilles for several 1940 passenger cars. Extremely light castings, including some for aircraft, in magnesium and in aluminum alloys, were deserving of special note.

EX-CELL-O CORP. centered its display on its fuel pump for injection engines in which the pump plungers are operated from a wabble plate. These pumps were shown both in assembled and dismantled forms and with supplementary units such as a transfer pump, accelerator and injection nozzles. Parts for the assemblies also were shown.

FABRISTEEL PRODUCTS, INC. confined its exhibit to a special form of stepped nut designed for insertion in thinner sheet metal, and the machine for feeding this nut automatically and staking it in place in holes punched in the sheet. Similar machines are reported in use by large automotive producers.

FLEMING MFG. CO. showed a new line of filters for diesel fuel and diesel lubricating oil as well as an accessory called a "Hydrovent" used for crankcase ventilation. This vent contains a gravity-actuated valve and is installed in a pipe connected between the crankcase and the inlet manifold to suck water vapor and other blow-by products from the crankcase. A new form of dip stick for lubricating oil, so made as to afford means for determining when oil is so dirty as to require renewal, was also shown.

FRUEHAUF TRAILER CO. showed a high-pressure portable greasing unit mounted on wheels and carrying a charger and battery to furnish current for a motor which drives the grease gun. No connection to an air line or electric line is required when the unit is in service, but it has its own high-pressure hose for carrying the grease from the gun to hand gun for use at grease fittings. When not in use, connection to an electric outlet recharges the battery.

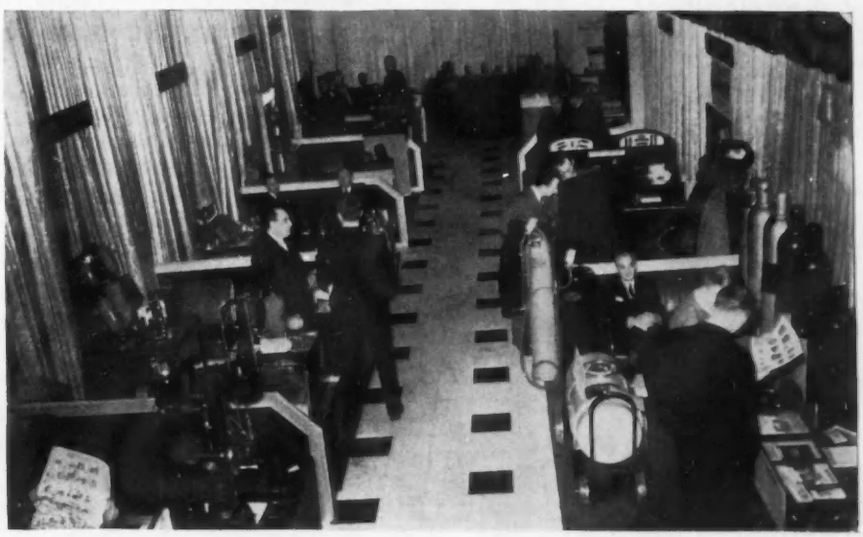
GARLOCK PACKING CO. showed a variety of its sheet packing and gasket materials as well as prepared gaskets cut to size from these sheets. Also displayed were samples of oil seals using both neoprene and other flexible materials, as well as leather cups and special seals, the latter for water pumps such as are used on automotive engines.

GEMMER MFG. CO. displayed one of its steering gears in a test stand equipped for hydraulic loading to simulate a steering load. The setup included gages arranged to show input and output torque and thereby measure the efficiency of the gear. Another steering gear cut away for display purposes and some of the individual parts used completed the exhibit.

HERCULES MOTORS CORP. confined its exhibit to diesel engines of which a flat horizontal model with 6-cyl in line was the largest and most prominent. In this engine, height is minimized by placing all accessories except the starting motor at one end. The remaining engines shown were more conventional vertical types, two having 4 cyl and one only 2 cyl. A large panel of supplementary parts and accessories formed a background for the exhibit.

KARL L. HERRMANN again displayed his barrel-type engine, shown last year, and some of the parts used in its construction. The engine has 12 cyl with double-end pistons arranged parallel to the engine axis and driving onto a common cam on the through shaft. It is understood that the engine has been run under full load for more than 300 hr since last shown, and it attracted much favorable comment.

JOHANSSON DIVISION OF FORD MOTOR CO. again had its comprehensive exhibit of gage blocks and supplementary precision measuring equipment, including a projector showing how same are used. One set of blocks shown permits of 120,000 differ-



ent gage sizes and some items make possible measurements to as little as two millionths of an inch. A sine bar, for precise angle measurements, and blocks for cross-checking between inch and metric measurements were among the items included.

LINK ENGINEERING & MFG. CO. showed some of the machines it produces for measuring spring tension. The latest of these is designed for measuring the spring tension (wall pressure) of piston rings either with or without expander springs and makes use of an electric "eye" to facilitate rapid indications when the machine is used in routine inspection.

MICROMATIC HONE CORP.'S exhibit was centered about its Micromatic honing machines and hones and certain of the products finished by them, including cylinder barrels, liners and the like. Among the latter were examples of co-directional honing in which the hone is moved parallel to the axis of the cylinder without rotation except for occasional hand indexing. A new form of hone with interlocking stones was also displayed.

MONROE AUTO EQUIPMENT CO. featured a large model of its shock absorber for railway use and other designs of shock absorbing devices for passenger cars, including one built into a cross strut. Other items in the display included anti-sway bars, jacks, shifter rods, axle struts, "Silenite" spring inserts and "Spraytex" body dope.

PERFECT CIRCLE CO. featured its new oil seal ring consisting of a pair of flat steel rings spaced apart and having between them a compensating spring so made as to slide slightly against the inside diameter of the ring when the latter is flexed. A large model of the ring was shown and a separate model of the spring to make clear how it is flexed and effects the required compensation. Samples of compression rings were also on display.

ROSS GEAR & TOOL CO.'S display included examples of its steering gears in which the housings were cut away to show interior parts. In the largest unit, the conical rollers which follow the screw thread were mounted on antifriction bearings, whereas the smaller and lower-priced models for lighter duty do not have this refinement.

SPICER MFG. CORP. occupied its usual stand and gave about equal prominence to its lines of universal joints with tubular shafts, a two-plate clutch, a truck gearset with five speeds and supplementary gear units for power take-off applications.

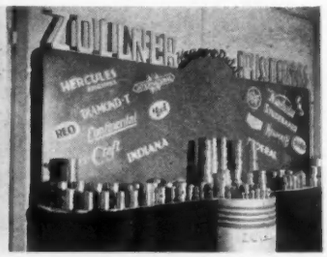
STEWART-WARNER CORP. had a dual or divided display, one portion featuring chiefly instruments, die castings and an electric windshield wiper and the other devoted to its "South-Wind" gasoline-type heater for automotive vehicles and to passenger car radios. Panels showing instruments featured several styles of speedometers and tachometers, many fuel, electric, temperature and pressure gages and the like. Several fine examples of die castings, both large and small and in both zinc and in aluminum alloys, were on view and one panel was devoted to Alemite fittings and pressure guns. Radios with neat button tuning panels and dash-mounted mast aerials received a due share of attention.

TINNERMAN PRODUCTS, INC. had an extensive display of its numerous types of fastening devices and of products in which they are used. These included not only "standard" "Speed Nuts" and "Speed Clips" but a large assortment of special fastening parts many of which perform other functions also. Snap clips for fastening moldings and handles, plastic knobs, die cast nameplates, bezels and the like, and many varieties of stamped parts were in evidence in this display.

VICTOR MFG. & GASKET CO. showed numerous examples of its gasket and oil seal products on two large display boards. The gaskets include copper-asbestos and steel-asbestos as well as other types containing cork and fibrous materials. "Victoprene" oil seals having steel retainers and neoprene sealing parts (some of them split, but mostly in continuous rings) were shown in a large range of sizes.

WAUKESHA MOTOR CO. confined its exhibit to two of its many types of engines, one of the two being its injection spark-ignition type in a 6-cyl 4½ x 5½-in. size. This model carried both an injection pump and a magneto of Bosch make and was shown fitted with a Bendix-Westinghouse compressor. The other engine displayed was a 6-cyl carbureting type equipped for magneto ignition.

ZOLLNER MACHINE WORKS showed a full line of aluminum alloy pistons designed especially for heavy duty engines varying in size from small outboard marine types to the large Winton diesels for locomotive service. A considerable proportion, furnished for diesel engines, have the piston head shape adapted, of course, to the particular form of combustion-chamber shape employed. Others had flat or stepped heads.



Reports of Committees

Meetings Committee Report

DURING the 1939 administrative year, the meetings program of the Society comprised eight meetings exclusive of regular Section meetings.

The World Automotive Engineering Congress, held from May 22 to June 8, was the longest and in many respects the most outstanding event ever staged by the Society. The World Automotive Engineering Congress was more than a meeting; in reality, it was a series of meetings, because the event opened with five days of technical sessions in New York City and was followed by attendance at the 500-mile Sweepstakes in Indianapolis, three days of inspection trips and a technical session in Detroit, and three days of technical sessions in San Francisco. Those who went from Coast to Coast with the SAE had an opportunity, of course, to visit both the New York World's Fair and the Golden Gate Exposition in San Francisco. The programs for the technical sessions were arranged for by the 10 Professional Activity Committees and, in addition to these, there were banquets in each of the four cities visited.

The Congress was truly international in character. Engineers from nine nations presented papers, and delegates from 20 countries attended the various sessions and participated in the discussions.

An innovation at the Fourth National Aircraft Production Meeting in Los Angeles in October was the aircraft engineering display, which proved a complete success. The attendance at this meeting shattered previous records for the National Aircraft Production Meeting.

Meeting	Place	Date	No. of Sessions	No. of Papers	Attendance*
Aeronautic	Washington, D. C.	March 16-17	9	12	240
World Automotive Engineering Congress	New York, Indianapolis. Detroit, San Francisco	May 22-June 8	36	59	1945
Tractor	Milwaukee, Wis.	Sept. 28-29	5	9	408
Aircraft Production	Los Angeles, Calif.	Oct. 5-7	8	16	863
Annual Dinner	New York City	Oct. 16	1	1	867
Transportation	St. Louis, Mo.	Oct. 26-27	6	8	135
Fuels and Lubricants	Tulsa, Okla.	Nov. 2-3	6	11	134
Annual	Detroit, Mich.	Jan. 15-19	20	42	

* Registered attendance at meeting; does not include dinner attendance.

There were five days of technical sessions at the 1940 Annual Meeting which were planned by nine of the Professional Activities. The Engineering Exhibit, which has given members an opportunity to examine new products at previous annual meetings, was repeated at the 1940 Annual Meeting.

The World Automotive Engineering Congress and the Annual Meeting were under the general supervision of the Meetings Committee, as were the Annual Dinner arrangements.

The Meetings Committee is duly appreciative of the cooperation furnished by the local Sections in connection with the various meetings and takes this opportunity to thank the Detroit, Indiana, Metropolitan, Milwaukee, Northern California, Northwest, Oregon, St. Louis, Southern California and Washington Sections and the Tulsa Group for their able assistance during the past year.

RALPH R. TEETOR, *Chairman*

Membership Committee Report

THE Membership Committee takes pleasure in presenting the following membership figures for the year 1939:

	1938 (as of Dec. 31)	1939 (as of Dec. 31)
Members	3044	3138
Associates	1516	1594
Juniors	452	496
Foreign Members	394	400
Service Members	88	98
Departmental Members	6	7
Affiliate Members	79	79
Additional Affiliate Member Representatives	42	49
	5621	5861
Enrolled Students	448	399
	6069	6260

An encouraging increase in applications received over the previous year is reported.

The cooperative spirit of the National and Section Membership Committees and individual members in connection with the promotion of membership work, has been an important factor in the increase of new members in the Society.

The Committee expresses sincere appreciation to all those who have worked so earnestly in the membership endeavors of the Society.

J. D. CEADER, *Chairman*

Publication Committee Report

DURING the past twelve months more papers have been presented before meetings of the Society than in any recent year. It is unfortunate that space limitations make it impossible to print all of the excellent material thus made available. The Society has reason to be grateful to the many special committees of volunteer readers who cooperate in selecting for publication those papers which appear to be of outstanding merit or unusual interest.

Particularly helpful also has been the work of the various Section Field Editors. Through their efforts much of the technical information derived from the various Section Activities has been made available to the entire membership through the "News of Sections" pages of the Journal.

A brief summary of the types of material used in the Journal during the past year has been prepared by the Executive Editor as follows:

During the calendar year of 1939, 842 pages of text and 422 pages of revenue advertising were published in the Journal. Of the text pages, 568 or approximately 67 per cent consisted of papers and discussion; 548 of these pages were published in the Transactions Section. In addition to these editorial text pages, an Index was published as usual. In 1939 it ran 44 pages in length. During the preceding year, 1938, 835 pages of text were published, of which 549 or 66 per cent consisted of papers and discussions. In 1938, there were published 401 pages of revenue advertising.

Seventy-one complete papers, some with discussion, were published during the year 1939. In addition, there were published three special articles which were part of a series of twelve on "Your Society."

In addition to digests of papers "included as an integral part of reports of meetings, 6½ pages of the Journal were devoted to printing other digests for purposes of record, brief abstracts of all papers presented at the various general and Section meetings of the Society having been printed. This practice was begun immediately following the 1934 Semi-Annual Meeting and is being continued as a regular part of the Journal program.

Transactions

Transactions of the Society were brought up to date by publication about the middle of January of Volume 33 covering the year 1938. In this volume there were 548 pages. It contained 64 complete papers and discussions.

Volume 33 was sold to members for $2, the charge being entered upon the bill for annual dues.

Roster

The SAE Roster for 1939 contained 13 more pages than the 1938 edition. Names of members on our Reserve Membership List are not included.

The Roster for 1940 will be issued about the middle of February.

STANWOOD W. SPARROW, *Chairman*

Research Committee Report

SIXTY-SEVEN committee meetings and numerous informal group conferences were held in the conduct of the Society's Research activities during 1939. These minutes and committee reports required the cutting of over 2000 mimeograph stencils.

Aircraft-Engine Lubricants

Early in the year the Aircraft-Engine Lubricants Research Committee adopted for trial use the aircraft-engine inspection forms formulated by a working group on the basis of experience gained in a series of engine inspections at the laboratories of the cooperating engine manufacturers. Further revision of the forms and their reconciliation with the forms in use at the National Bureau of Standards were effected and an edition of 1500 released by the Committee

in July. Engine inspection data are being accumulated on these forms and cooperating aircraft-engine builders and operators in this Country and Canada are submitting their results to the National Bureau of Standards for analysis.

As a result of the activities of the subcommittee on laboratory methods of testing used oil, working in cooperation with Committee D-2 of the American Society for Testing Materials, a Proposed Method of Test for Neutralization Number of Used Aviation Oils has been published for information in the current report of Committee D-2. Work is in progress on proposed methods for measuring chloroform and naphtha insolubles.

Concerted effort is being directed toward the standardization of a method for photographing engine parts, the first step in this project being the development of a light box with a given amount of illumination and uniform light intensity.

Crankcase Oil Oiliness

Although the first series of comparative wear tests, in which mineral oil and a compounded oil of mineral oil and sperm oil were used, were inconclusive, the Crankcase Oil Oiliness Research Committee agreed to continue its program under substantially more severe test conditions using a mineral oil and a compounded oil made up of the mineral oil plus a compounding agent selected from among the several commercially available (the identity of the compound being concealed). The program is exploratory in nature and accordingly provides for considerable latitude in the use of diverse equipment and test methods. Twelve laboratories are participating in both engine and bench tests.

A tentative list of symbols for quantities commonly used in lubrication publications, prepared as a result of discussions at the International Conference on Lubrication held in London in 1938, was presented by Prof. H. A. Everett, an SAE representative at the Conference, to the members of the Crankcase Oil Oiliness Research Committee, and the Committee's recommendations were in turn transmitted through Professor Everett to the Institution of Mechanical Engineers, under whose auspices the matter is being considered.

Crankcase Oil Stability

A year ago a series of oils of SAE 40 viscosity, having known service records, were rated, under code designations, by 13 cooperating laboratories and the data analyzed by a special group. The Committee voted to continue to keep secret the identity of the test oils, but authorized a report showing a comparison, by code letter, of the service and laboratory results. Such a study indicated a fairly close agreement between the various laboratory tests and the service ratings of the oils based on their performance in the field. Participating laboratories were requested to furnish additional information on a number of points affecting correlation of the laboratory and service ratings. The data on the SAE 60 oils, which constitute the second half of the current program, were received from all but two participants, and have been studied by the Analysis Group. On the basis of the results and opinions reported, the Program Group has proposed a further cooperative program which provides for testing of three samples each (of high, intermediate, and low stability) of SAE 20 and SAE 60 oils. The No. 20 oil is representative of the light oil consumed in greatest quantity, while the No. 60 oil is representative of aircraft oil.

[1] See SAE Transactions, Vol. 34, Oct., 1939, pp. 449-456: "The Precision of Knock Rating – 1936-1938," by D. B. Brooks and R. B. Cleaton.

[2] See SAE Transactions, Vol. 34, June, 1939; pp. 277-280: "CFR Research Method of Test for Knock Characteristics of Motor Fuels."

Extreme-Pressure Lubricants

Two additional SAE Extreme-Pressure Lubricant Testing Machines have been built by the Highway Trailer Co. from an overrun of parts left after completing the third production lot in 1937. These machines have been sold, with the approval of the Executive Committee, to the National Bureau of Standards and Vauxhall Motors, Ltd. SAE Machines in service now total 47.

As a sequal to criticisms of the surface finish of the test cups for the machine, the Timken Roller Bearing Co. made available test cups carrying a higher degree of finish than that used on the standard cups. Over a thousand of these cups with special finish have been purchased by a group of laboratories participating in comparative tests.

The Operators Division of the Committee is formulating a memorandum of important facts which are fairly well established and which may be of assistance to operators generally in the absence of specifications for Extreme-Pressure Lubricants. This memorandum is being prepared for presentation to the Transportation and Maintenance Activity of the Society.

Highways

The Highways Research Committee, with the approval of the General Research Committee, acted jointly with the Transportation and Maintenance Activity in transmitting to the SAE Standards Committee "Recommended Safety Features Involving Trailer Couplings" with a recommendation that this report be published in the SAE Handbook as a Recommended Practice. Work was continued during the past year toward standardization of kingpin offset and the design of the kingpin itself with the result that a kingpin design, having general approval, was transmitted by the General Research Committee to the General Standards Committee with the recommendation that this design be considered for standardization. A proposed recommended standard for kingpin offset, formulated after a careful study of present practices and to some extent of theoretical considerations, has been under consideration by the Committee during the past months.

A survey and study have been made of all available published information on the subject of instrumentation and procedure for measurement of tractive effort between tires and the road, in accordance with the General Research Committee's authorization of an undertaking on this subject to be handled by the Highways Research Committee in cooperation with the Highway Research Board of the National Research Council.

The Highways Research Committee has continued its cooperation with the American Standards Association submitting available technical information as required on the problems involved in motor-vehicle inspection.

Ignition

Discussion of the proposed specification for high-tension ignition cable for aircraft use indicated that the Committee was not in a position to reconcile the several specifications and formulate a satisfactory specification for commercial service. Difficulties heretofore attributed to other parts of the ignition system were found to lie in the cable. The Committee is attempting to secure cable with, among other characteristics, a high degree of resistance to moisture. Individual laboratories among the cooperating companies are accumulating data on some of the important factors affecting the performance of ignition cable in aircraft.

Efforts are being made to expedite the work of the Subcommittee on Methods of Rating Spark Plugs.

Riding Comfort

Through the efforts of Chairman R. W. Brown, descriptions of several additional instruments for measuring riding comfort have been made available to supplement the summary of such descriptions prepared by Mr. Brown a year ago. An exchange of riding comfort bibliographies and extracts from important papers on suspension, riding comfort, and allied subjects has been arranged with C. G. Williams of the Institution of Automobile Engineers who visited this country during 1939.

Upon advice of the Riding Comfort Research Committee, the Chairman has made arrangements for the preparation of a report on the pedometer as an instrument for evaluating riding comfort, particularly with regard to the source and extent of errors which might occur when it is used as a vibration measuring instrument. Preliminary steps have been taken to secure discussion from passenger-car engineers of the Committee's work, and to solicit a report from Prof. W. E. Lay covering seat-cushion research in progress at the University of Michigan.

Cooperative Fuel Research

The Society has continued to act as the secretariat for the Cooperative Fuel Research Committee, in the sponsorship of which it is joined by the Automobile Manufacturers Association, the American Petroleum Institute, and the National Bureau of Standards.

This work is supervised by five divisions:

I. Motor Fuels Division
II. Aviation Fuels Division
III. Automotive Diesel Fuels Division
IV. Non-Petroleum Fuels Division
V. Survey Division

The Motor Fuels Division has instituted a new group of Projects on Volatility for the purpose of studying the relation of fuel volatility to automobile engine performance characteristics, particularly distribution through influence of manifold temperatures and other factors, and the operation of automatic chokes. A sub-group is surveying available information preliminary to the formulation of a program.

The Division has continued its investigations on Detonation Projects including studies of: (1) improvements in instrumentation; (2) possible modifications in the CFR knock-testing engine for rating fuels at high altitude; (3) the need for humidity control to improve the precision of knock ratings; (4) improvements in the CFR knock-test engine; (5) the precision of knock rating by the current method[1]; and (6) the purity of reference fuels.

The Division organized a program of decentralized research on road knock testing which was carried out by individual organizations and reported at a symposium session of the SAE Annual Meeting. It has developed a new method of knock testing to replace the old Research Method,[2] which gives results substantially the same as those obtained by the old method but with increased precision and more facility in changing the test equipment from the conditions of the ASTM Method.

The Aviation Fuels Division has added a fifth group of projects to its program during the year 1939. These Volatility Projects have been formed for the purpose of determining the effect of volatility of aviation gasoline on the operation of the full-scale engine. This undertaking is directed toward clearly defining all volatility requirements including such items as distribution, roughness and acceleration, torching, vapor lock, boiling, and deterioration in storage; and, in addition, to a major program of full-scale dynamometer tests using a wide variety of carefully selected fuels, will include months of flight testing with experimental fuels under service conditions.

The cooperative programs on Full-Scale and Laboratory Detonation Projects have continued. The object of the Full-Scale Detonation Projects is to investigate the action of fuels in various full-scale aircraft engines and to coordinate these results with those obtained with the single-

cylinder engine under the Laboratory Detonation Projects. During the past year the cooperating engine laboratories have made comparisons of leaded reference fuels with unleaded reference fuels; have rated leaded aromatic fuels including toluene plus lead and benzene, and toluene plus lead of approximately 95 octane number, and compared the full-scale results with laboratory ratings of the test and reference fuels; and have tested four leaded reference fuels under take-off conditions. The Laboratory Detonation Projects have been concentrating on the development of a new method of rating aviation gasolines in the single-cylinder test engine. Two laboratories have been working intensively with 11 other laboratories carrying out check test work. A Proposed Tentative CFR Method of Test for Knock Characteristics of Aviation Fuels is being given trial use in the cooperating laboratories in the hope that there will be available early in 1940 a method for testing aviation gasoline in the test engine which will be superior to the present "Method of Test for Knock Characteristics of Motor Fuels" (ASTM Designation D 357 – 39), and will make it possible to substitute the new method for the two methods now in use in the industry. The Reproducibility Project has been organized on a more formal basis and expanded to include 15 laboratories. It is hoped that, from the eight proposed methods of extending the octane scale beyond the present 100 octane number limit, one method will soon be selected and adopted as standard.

The progress on the vapor lock projects was covered in a paper recently presented to the Society.[3] A comprehensive report of over a hundred pages covering progress on all phases of the Vapor Lock Projects, from inception to date, was prepared by Dr. O. C. Bridgeman, Director of the Projects, and made available in mimeographed form to members of all the Vapor Lock Groups. It is expected that the laboratory test program on pressure drops and flow through fuel lines, fittings, and coupled accessories, being carried out on the laboratory test set-up at the National Bureau of Standards, will be completed early in 1940. A study is being made of the vapor lock problem under very high altitude conditions.

The scope of the Corrosion Projects has been expanded. during the past year, to include a study of the effect of exhaust gases on aluminum parts. Fuels, Materials, Design and Manufacture, and Maintenance Groups are cooperating in the circulation of questionnaires to the industry to obtain information, and are providing constructive analyses of the various phases of the problem. A series of corrosion tests have been concluded after one year's exposure. It was found that none of the 15 fuels or fuel mixtures in the absence of added water had any severe action on the several aluminum alloys used for gasoline tanks. Samples of airplane sump waters are being collected, analyzed, and, if available in sufficient quantity, are being used in corrosion tests using specimens of standard aluminum alloys.

The Automotive Diesel Fuels Division recently adopted a test program on Volatility Projects recommended by the Full-Scale Engine Group, composed of nine engine manufacturers representative of the four essential types of engine; and has approved the four reference fuels which were selected to represent the range of fuel characteristics the Group desires to test, and which permit of cross blending to obtain all conceivable combinations. The tests will include a comprehensive study of those engine performance factors, such as power, economy, smoke, carbon deposits, etc., which are influenced by fuel characteristics.

The Division has, through its Exchange Group, collected data on the reproducibility of its "Proposed Method of Test for Ignition Quality of Diesel Fuels," published "for information" in 1938 by the American Society for Testing Materials. This group of 23 laboratories has been organized on a more formal basis to exchange three samples per month. From a study of such data collected during 1939 it appears that the deviations obtained in determining cetane numbers are about 2.5 times as great as those obtained in determining octane numbers by the ASTM Method. The results indicate that there are certain engine factors which influence the results and these are the subject of a cooperative study.

The Non-Petroleum Fuels Division was inactive during 1939.

The Survey Division has continued its three projects: Aviation Fuels Projects; Motor Fuels Projects; and Motor Projects. The specifications for five grades of aviation gasoline for domestic commercial use, having octane number designations 73, 80, 87, 90 and 95 octane number, respectively, with a single specification for all of the fuel criteria, except lead content, originally developed by the Groups working on Aviation Fuels Projects of the CFR Survey Division, were referred to Committee D-2 on Petroleum Products of the American Society for Testing Materials with a recommendation that they be considered for standardization. The specifications are published for information in the current report of Committee D-2.

The Committee has continued its cooperative agreement with the National Bureau of Mines whereby the Bureau completes the analysis of data collected by the Committee in a National motor gasoline survey, and issues a semi-annual report covering the winter and summer gasolines sold throughout the Country. The eighth survey handled under this joint agreement has just been released.

The Groups working on Motor Survey Projects have cooperated with the Motor Fuels Division and the Automotive Survey Committee of the American Petroleum Institute in carrying out 1939 cooperative road tests along similar lines to those conducted in the 1938 survey for securing octane number and limiting vapor pressure requirements for automobiles. The Procedure Group worked out detailed revisions of the Procedures for Determination of Octane Number Requirements and for Determination of Vapor Pressure Requirements and these were made available to participants. An outline covering the practical application of these data was presented at the 1940 Annual Meeting by J. B. Macauley, Jr., Chairman of the Survey Division.[4] Tests were conducted on 1937, 1938, and 1939 models of any make of car; the results were reported by D. B. Brooks of the National Bureau of Standards at the 1940 Annual Meeting.[5]

G. W. Lewis, *Chairman*

[3] "Investigation of Vapor Lock in Aircraft Fuel Systems," presented at the National Aircraft Production Meeting of the Society, Oct. 5-6, 1939.

[4] "Gasoline Cars and Surveys," presented at the Annual Meeting of the Society, Jan. 15-19, 1940.

[5] "Results of the 1939 Motor Survey," presented at the Annual Meeting of the Society, Jan. 15-19, 1940.

Sections Committee Report

THE records show that more SAE members attended Section meetings during 1939 than in several past years. Governing Boards got together early, planned meetings that would appeal to their members, and did a splendid job of publicizing these meetings. Every effort was made to encourage the attendance of every member in the Section. Several Sections continued the policy of holding closed meetings (for SAE members only). Others limited a few of their meetings to SAE members and one invited guest.

The general consensus for 1939 was that throughout all Sections of the Society the most worthwhile topics were presented, discussed, and considered by those most highly specialized and qualified on each subject.

The topics discussed by the Sections during the year are shown in the following table. The topics mentioned here refer only to Section meetings, and do not include those discussed at National Meetings held in Section cities.

Aeronautics	23
Fuels and Lubricants	19
Transportation and Maintenance	16
Diesel Engines	15
Parts and Equipment	13
*General	12
Metallurgy	10
Passenger Cars	10
Social	10
Trucks, Buses and Railcars	8
War and Armament	7
Production	5
Electrical Equipment	5
Bodies	4
Research	3
Plastics	3
Tractors and Industrial Power Equipment	1

Committee Work

Committees in the Sections were composed of picked members qualified for the particular work. Each Committee Chairman was careful to organize a personnel that would be active and take an interest in the job assigned to them. The number of members working on the various Section Membership Committees alone totaled over 400, each one of whom was supplied with helpful material to assist in the membership increase work of his Section. Many Sections had their Membership Committees divided into Subdivisions, each Subdivision having its own vice-chairman and a crew of active workers in a particular branch of the industry. Reception Committees carried on effectively, and the Placement Committees exhibited considerable progress in the placement problems of their Section members and cooperated effectively with headquarters. The quality of the papers presented before the Sections during 1939 speaks very highly of the ability of the Meetings Committee Chairmen. Student Committee Chairmen were supplied with lists of approved colleges in their territories and they took an active interest in student events in the Section and the Society. Field Editors, too, did their part in keeping the SAE Journal informed of Section meetings.

The Tulsa Group

1939 marked the second year of operation of the SAE Tulsa Group. The Group met regularly during the year and cooperated most effectively with the Society in the staging of the National Fuels and Lubricants Meeting held in Tulsa in November. Membership increased in the territory and a stimulating spirit of cooperation pervaded all events of the Group.

The Colorado Club

Informal operations of the Colorado Club continued throughout 1939. Recent developments indicate that it is the desire of this group to increase activities in order that they will attract more members.

Student Branches

Another SAE Student Branch was added to the list during 1939. The University of Wisconsin, at Madison, Wis., applied to the Council for the formation of a Student Branch, and approval was granted on March 17, 1939. Since its formation, it has been outstanding in its number of SAE enrolled students, the type and

* The general papers were on such subjects as Highways of Tomorrow, Factors Influencing Engineering Organization, Where Do We Go From Here, and the like.

quality of its meetings, and the interest and activity exhibited by all connected with it. Much credit for the organization of the Branch and for its successful operation belongs to the Milwaukee Section. The Section invites the officers of the Branch to sit in at Governing Board meetings, and in many ways participate in the work of the Section.

The Society now has 11 Student Branches located as follows:

General Motors Institute – Flint, Mich.
Massachusetts Institute of Technology – Cambridge, Mass.
New York University – New York, N. Y.
Ohio State University – Columbus, Ohio
Oregon State College – Corvallis, Ore.
Purdue University – West Lafayette, Ind.
University of Alabama – University, Ala.
University of Detroit – Detroit, Mich.
University of Michigan – Ann Arbor, Mich.
University of Oklahoma – Norman, Okla.
University of Wisconsin – Madison, Wis.

Student Branches located in Section centers enjoyed the active cooperation of the Section officers during the year. Indications are that the Student Branches are working more closely with their Sections, with definite evidences of progress as a result.

The Section officers and their Governing Boards are to be congratulated on their achievements during 1939. It was a year of advancement in many lines of Section operation, a year in which the Section members were the recipients of much in the way of fine Section meetings and generally improved Section activities.

F. K. GLYNN, *Chairman*

Treasurer's Report

THE fiscal year that ended Sept. 30, 1939, showed a deficit of $10,652.57. The budget for the fiscal year provided for a deficit of $8430, as the Council and Finance Committee voted to draw on surplus so as not to hamper the activities of the Society to its membership by attempting to operate on a balanced budget. The deficit, 26% greater than budgeted, was due to decline in SAE Journal advertising.

Income and expenses for the year as compared with budgeted figures were:

	Actual	Budgeted
Total Income	$233,403.39	$251,125.00
Total Expense	244,055.96	259,555.00

Actual income and expense for the fiscal year ending Sept. 30, 1939, compared with the previous fiscal year were:

	Ending Sept. 30, 1939	Ending Sept. 30, 1938
Income	$233,403.39	$246,827.07
Expense	244,055.96	248,448.03

Income for the fiscal year just closed was $13,423.68 less than for the previous fiscal year, and expenses were $4,392.07 less.

Journal advertising incomes during the fiscal year was $15,016 less than during the 1937-38 fiscal year.

The comparative Balance Sheet and Income and Expense statements, which are a part of this report, detail the Society's finances as of Sept. 30, 1939, and also contain corresponding figures for the fiscal year ending Sept. 30, 1938.

During the past fiscal year the investment portfolio of the Society was reduced by $256.25. This was due to the fact that some of the securities were called during the year and the funds received were reinvested. At the close of the fiscal year the total book value of securities held was $220,411.02 and their actual market value on the same date was $210,324.37.

As is customary each year, the books of account have been audited by Haskins and Sells.

DAVID BEECROFT, *Treasurer*

BALANCE SHEET AS OF SEPT. 30, 1939

Assets

Cash	$ 13,147.87
Accounts Receivable	4,731.64
Securities	*220,411.02
Accrued Interest on Securities	2,588.09
Inventories	771.90
Furniture and Fixtures	1,000.00
Items Paid in Advance, Charges Deferred	4,434.94
TOTAL ASSETS	$247,085.46

Liabilities and Reserves

Accounts Payable	$ 3,964.10
National Dues and Miscellaneous Items Received in Advance	12,681.95
Reserve Set Aside for Anticipated Expenses	8,744.04
General Reserve	232,347.94
Net Unexpended Income	†10,652.57
TOTAL LIABILITIES AND RESERVES	$247,085.46

* Book Value (Market value, Sept. 30, 1939 – $210,324.35)
† Deficit

INCOME AND EXPENSE AND BUDGET COMPARISON
12 MONTHS, ENDING SEPT. 30, 1939

Income

	Oct. 1, 1938 to Sept 30, 1939	Budget 1938-1939	Oct. 1, 1937 to Sept. 30, 1938
Dues and Subscriptions	$ 84,968.05	$ 83,000.00	$ 83,281.28
Initiation Fees	12,476.00	14,000.00	14,732.50
Interest and Discount	7,987.77	8,000.00	7,987.66
Affiliated Appropriations	17,343.75	18,125.00	18,281.25
Advertising – Journal	76,019.00	100,000.00	91,035.00
Advertising – Handbook	5,625.00	6,000.00	4,825.00
Miscellaneous Sales	26,425.75	22,000.00	24,579.82
Unused Portion of Section Dues	2,789.32	.....	1,689.73
Profit on Sale of Securities	†231.25	.....	414.83
TOTAL INCOME	$233,403.39	$251,125.00	$246,827.07

Expenses

Research	$ 15,222.11	$ 14,800.00	$ 15,145.45
Standards	7,941.97	8,180.00	7,972.76
Publications	50,884.42	51,050.00	49,929.23
Sections	7,570.22	9,080.00	7,660.28
Meetings	19,452.82	25,710.00	19,100.48
Institutional Promotion	1,890.57	1,500.00	1,509.87
Professional Activities	153.56	400.00	368.64
Membership Increase	10,970.99	12,100.00	12,383.67
Advertising – Journal	29,344.18	31,980.00	30,824.13
Advertising – Handbook	1,095.69	1,170.00	926.16
Miscellaneous Sales	9,644.15	10,000.00	10,020.99
General Expenses	78,337.65	81,085.00	80,812.06
Engineering Relations	11,547.63	12,500.00	11,794.31
TOTAL EXPENSE	$244,055.96	$259,555.00	$248,448.03
Net Unexpended Income	†$ 10,652.57	†$ 8,430.00	†$ 1,620.96

† Deficit

Standards Committee Report

THE activities of your Standards Committee during the year have been progressively concentrating on some new developments in standardization and on the more important projects, including revision of existing standards. Industrial and economic conditions have tended to restrict members of the Committees, and in several instances their work has been influenced by unusual conditions that it was necessary to take into consideration.

SAE Standards Committee

The general organization of the Standards Committee at the beginning of 1939 was the same as the preceding year, except for several personnel changes and discontinuation for the time being of the Motorboat and Marine Engine Division because of prevailing conditions. During the year an important new Division, the Aircraft Materials Division, was established by the Council to formulate a new class of material specifications for the aircraft and aircraft-engine industries to meet their more exacting requirements. This work was originally started by the Engine Technical Committee of the Aeronautical Chamber of Commerce of America, but at their request was transferred to the SAE as the appropriate national body for such standardization. These new specifications, a number of which have already been completed by the

Division, have been coordinated so far as possible with present SAE material specifications such as the steels and non-ferrous metals. They will be assigned a new system of identifying numbers with the prefix AMS (Aeronautical Material Specification) and will be published individually on letter-sized sheets.

In the field of parts standardization, work has been completed or nearly completed on revised or new specifications for Subsize Test Specimens for Steel, Electric Lamp Bulbs, Sealed Beam Headlamp Units, and American Standards for Involute Splines, Taps, and Round Unslotted Head Bolts. Dimensional standards for Tractor-Trailer King Pins and King Pin Offsets and revised standards for Ignition Cable and Automobile Wiring are in progress.

Among the more important standards for materials that have progressed through the Standards Committee aside from the aircraft materials referred to above, are the specifications for Wrought Copper and Copper Alloys, Gear Bronzes, Aluminums, Main and Connecting Rod Bearings, Magnesium Alloys, Felt Specifications, Lubricating Grease Consistency and a study of Lubricating Oil Viscosities.

A new set of standard engine-testing forms for aircraft engines, as well as complete revision of the present gasoline-engine and diesel-engine testing forms are now in special Subcommittees.

The heat treatment notes for steels have been reviewed and materially condensed into much more convenient reference form, and a small group has been appointed to prepare a recommendation for defining non-metallic inclusions in steels.

New specifications for Headlighting including the Photometric Laboratory Tests for Sealed Beam Headlamps have been developed to supplement the present headlamp specifications of the multiple beam types, and the specifications for auxiliary lamps and reflex reflectors are being brought up to date.

Perhaps one of the most important projects under present conditions on which the Standards Committee has been working some time is the development of an inch and metric standard system of high strength screw threads with rounded roots for aircraft uses. This study has included international practice, especially for metric threads, which is an important consideration to the aircraft industry.

In the field of more restricted applications considerable has been accomplished during the year toward agreement on a standard method for testing Tractor Air Cleaners, which is perhaps one of the most important accessories on tractor and industrial equipment engines.

Cooperation in Other Activities

Of particular importance is the organization of a joint Technical Committee with the ASTM that has made marked progress during the year toward a classification of rubber products other than tires for use in automotive vehicles, and the development of and instrumentation for reliable tests that can be used in production inspection. It is anticipated that this work will eventually lead to the formulation of standards for mechanical rubber parts by the SAE Standards Committee.

During the year the U. S. Department of Commerce established the Interdepartmental Committee on Screw Threads for coordinated standardization of screw threads and related parts for the various Governmental services. The Standards Committee in cooperation with the American Society of Mechanical Engineers and the American Standards Association established liaison representation on the Committee in the interest of full coordination of its program with industrial standardization.

In the field of standardization under the procedure of the American Standards Association, the Standards Committee has continued its cooperation through the Sectional Committees for which it is a sponsor or on which it is represented, as heretofore. The Society is sole sponsor for and organized a new Sectional Committee on Aeronautics, largely to cooperate in international standardization and assisted in reorganizing the Sectional Committee and its project for standardization on Wire and Sheet Metal Gaging. The Sectional Committee on Ball and Roller Bearings sent representatives to the meeting of the International Committee (ISA 4) at Helsingfors, Finland, last June at which material progress was made on uniform international standards. Many of the other projects under ASA procedure in which the Society cooperates such as on screws, bolts and nuts, small tools and machine tool elements and roller chains, have made progress during the year.

SAE Handbook

The improved 1939 edition of the Handbook was issued early in the year and was widely distributed throughout the world. Considerable new and revised material is in preparation for the 1940 edition, for which preparations for publication will commence immediately following the Annual Meeting. All members of the Society will as usual receive copies of the new edition when published.

General

Notwithstanding the difficulties of present conditions, the work of your Standards Committee is moving forward steadily to meet the changing requirements of both the automotive industry as such and of associated and other industries in which related standardization takes an important place. Industry's appreciation of the values of standardization continues to grow and your Committee urges even greater support of this work by industry management so that the Society can maintain its leading position in it for the benefit of both industry and Government.

JOHN H. HUNT, *Chairman*

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Dec. 15, 1939, and Jan. 15, 1940.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Baltimore Section

DOTY, LEONIDAS, JR. (J) engineer, charge of automotive division, Koppers Co., American Hammered Piston Ring Div., Bush & Hamburg Sts., Baltimore Md. (mail) P. O. Box 626.

Detroit Section

BAKER, G. D. (A) sales manager, Bundy Tubing Co., 10951 Hern Ave., Detroit.

BELL, EARL O. (J) plant engineer's assistant, Aluminum Co. of America, Detroit (mail) 2549 Field Ave.

CHAPIN, LAMBERT (J) junior engineer, Chrysler Corp., 12800 Oakland Ave., Detroit (mail) 111 Highland Ave.

INGRAM, WM. T. (J) experimental engineer, Chrysler Corp., 12800 Oakland Ave., Detroit (mail) 209 Colorado Ave.

MCCARTHY, CHARLES S. (M) vice-president, assistant general manager, Bingham Stamping & Tool Div., Logan Gear Co., 1062 Post St., Toledo, O. (mail) 2042 Upton Ave.

REESE, C. J. (A) president, general manager, Continental Motors Corp., 205 Market St., Muskegon, Mich. (mail) 1710 Ford Bldg., Detroit.

Indiana Section

ATKINSON, ROBERT P. (J) engineer, Allison Engineering Division, General Motors Corp., Indianapolis (mail) 4921 Ford St.

NEWCOMBE, JOHN WADE (M) chief chemist, D-A Lubricant Co., Inc., 1311 W. 29th St., Indianapolis.

Metropolitan Section

BROWNE, KENNETH ALAN (M) project engineer, Wright Aeronautical Corp., Paterson, N. J. (mail) R.F.D. No. 2, Westwood, N. J.

BURDEN, WILLIAM A. M. (A) vice-president, National Aviation Corp., 111 Broadway, New York.

CHARSHAFIAN, JACK O. (J) senior test engineer, Wright Aeronautical Corp., Paterson, N. J. (mail) 541 40th St., North Bergen, N. J.

KASSCHAU, KENNETH (J) junior test engineer, Wright Aeronautical Corp., 132 Beckwith Ave., Paterson, N. J. (mail) 72 Ridge Rd., Ridgewood, N. J.

NOLF, WILLIAM RAYMAN (J) production planning, Wright Aeronautical Corp., Paterson, N. J.

OTTO, EVERETT W. (A) automotive engineer, Standard Oil Co. of N. J., 15 Washington St., Newark, N. J.

QUIMBY, ELLIS S. (A) general manager, J. L. Quimby & Co., 278 Water St., New York.

New England Section

OKURO, ARNOLD R. (A) automotive instructor, Franklin Union Technical Inst., Boston. (mail) 101 Addington Rd., West Roxbury, Mass.

St. Louis Section

BEARD, JAMES A., JR. (M) engineer (automotive division), Wagner Electric Corp., St. Louis, Mo. (mail) 3626 Oakdale, Pine Lawn, St. Louis Co., Mo.

Southern California Section

AINSWORTH, LAINE JOHNSTON (J) engineer, F. A. B. Mfg. Co., 67th & Vallejo Sts., Oakland, Calif. (mail) 2912 Claremont Ave., Berkeley, Calif.

GLASS, SIDNEY (J) draftsman, Lockheed Aircraft Corp., Burbank, Calif. (mail) 542 N. Cummings St., Los Angeles.

GLOVER, THOMAS O. (A) bus foreman, Board of Education, 1425 S. San Pedro St., Los An-

geles (mail) 8920 Sepulveda Blvd., San Fernando, Calif.

LANGLEY, H. J. (M) U. S. Spring & Bumper Co., Magnolia Ave. & E. 50th St., Los Angeles.

SMITH, GARDNER (A) district manager, Toledo Steel Products Co., Toledo, O. (mail) 123 E. Windsor Rd., Glendale, Calif.

Washington Section

LOWRY, JOHN G. (J) junior aeronautical engineer, National Advisory Committee for Aeronautics, Langley Field, Hampton, Va. (mail) 112 Linden Ave.

Outside of Section Territory

CLARKE, JAMES ARTHUR (J) instructor, Provincial Inst. of Technology & Art, Calgary, Alberta, Canada.

CLOUD, HAROLD W. (M) manufacturing planning engineer, Sealed Power Corp., Muskegon, Mich. (mail) 1354 Lake Shore Drive.

KUPFERSCHMID, WILLIAM FROHMAN (M) production engineer, Electric Auto-Lite Co., Moto-Meter Div., LaCrosse, Wis.

OLMSTEAD, EDWIN H. (J) mechanical engineer, Well Surveys, Inc., 412 S. Kenosha, Tulsa, Okla. (mail) Baltimore Arms.

Foreign

HASSAN, WALTER THOMAS FREDERICK (FM) experimental engineer, S. S. Cars, Ltd., Coventry, England (mail) 61 Keresley Rd.

Applications Received

The applications for membership received between Dec. 15, 1939, and Jan. 15, 1940, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Baltimore Section

LONG, RAYMOND THOMAS, superintendent of automotive maintenance, Sherwood Bros., Inc., Baltimore.

THIEBLOT, ARMAND J., chief engineer, Fairchild Aircraft Corp., Hagerstown, Md.

Buffalo Section

DUDLEY, ERIC, materials engineer, Curtiss Aeroplane Division, Curtiss-Wright Corp., Buffalo.

Canadian Section

GARNETT, ROY A., junior engineer, Whiting Corp. (Canada) Ltd., Toronto, Ont., Canada.

Chicago Section

BRODIE, A. L., technologist, The Texas Co., Chicago.

LARSEN, GILBERT E., garage superintendent, Ward Baking Co., Chicago.

NEBESAR, DR. ROBERT J., chief engineer, Howard Aircraft Corp., Chicago.

RHOADES, WELDON E., air line pilot, United Air Lines Transport Corp., Chicago.

Cleveland Section

AUFMUTH, RAY B., experimental engineer, Thompson Products, Inc., Cleveland.

FULLER, ERNEST W., chief engineer, aero. division, The Acrotorque Co., Cleveland.

JACKSON, EDWARD D., vice-president, The Acrotorque Co., Cleveland.

MERRIMAN, JAMES C., assistant to service engineer, Thompson Products, Inc., Cleveland.

Detroit Section

BROWN, HENRY CLAY CURTIS, metal polisher, Motor Products Corp., Detroit.

CHAMBERS, JOHN M., chief engineer, Ferguson-Sherman Mfg. Corp., Dearborn, Mich.

HAMMOND, MILTON B., engineer and sales, The Gordon Mfg. Co., Toledo, O.

HARRISON, JAMES R., salesman, Wilcox-Rich Division, Eaton Mfg. Co., Detroit.

HOEHN, VINCENT H., junior engineer, Packard Motor Car Co., Detroit.

KRESS, RALPH H., Chevrolet Motor Division, General Motors Corp., Detroit.

O'CONNELL, FRANCIS P., chemical engineer, Baldwin Rubber Co., Pontiac, Mich.

PRETZ, PHILIP H., engineer, Cadillac Motor Car Division, General Motors Sales Corp., Detroit.

STRICKLAND, RUSSELL, sales engineer, Bower Roller Bearing Co., Detroit.

UDALE, STANLEY MARTIN, Holley Carburetor Co., Detroit.

TREMBATH, ROBERT S., dynamometer operator, Reo Motors, Inc., Lansing, Mich.

WILEY, ROBERT D., factory manager, Bundy Tubing Co., Detroit.

Kansas City Section

CORBETT, ALLEN H., sales manager, General Auto Parts Co., Kansas City, Mo.

Metropolitan Section

ARMSTRONG, WILLIAM, chief engineer, Dowty Equipment Corp., New York.

BANCEL, PAUL, test engineer, Wright Aeronautical Corp., Paterson, N. J.

GRAY, H. LIGGETT, assistant manager, Oakite Products, Inc., New York.

JEROME, JACK, assistant chief engineer, Air Associates, Inc., Garden City, N. Y.

KELLY, DALE, teacher, Brooklyn High School of Automotive Trades, Board of Education, New York.

MCELORY, JOHN E., junior test engineer, Wright Aeronautical Corp., Paterson, N. J.

MUDGE, WILLIAM A., metallurgist, development and research division, The International Nickel Co., Inc., New York.

RICHARDS, WILLIAM MERRIL SHAW, test engineer, Wright Aeronautical Corp., Paterson, N. J.

TEN EYCK, HAROLD ROBERT, 561 N. Broadway, Yonkers, N. Y.

Milwaukee Section

BRIGGS & STRATTON CORP., Milwaukee.

STEVENS, BROOKS, owner, Brooks Stevens – Industrial Design, Milwaukee.

SWAIN, JOHN GRANT, sales manager, Waukesha Motor Co., Waukesha, Wis.

New England Section

GOOGINS, DANFORTH M., automotive engineer, Socony-Vacuum Oil Co., Inc., Boston.

Northern California Section

AFFLECK, THEODORE HUBBARD, representative, Westinghouse Air Brake Co., San Francisco.

SILVA, EUGENE E., junior engineer, U. S. Forest Service, San Francisco.

WALKER, ALVIN R., research engineer, Tide Water Associated Oil Co., Associated, Calif.

WIMBERLY, DONALD C., research engineer, Standard Oil Co. of Calif., Richmond, Calif.

Philadelphia Section

PECKER, JOSEPH S., president, Machine & Tool Designing Co., Philadelphia.

Pittsburgh Section

TURNER, RUSSELL J., president, Castle Rubber Co., East Butler, Pa.

St. Louis Section

BRUNDIGE, RAY H., transportation engineer, Columbia Terminals Co., St. Louis, Mo.

Southern California Section

BAER, ALVIN WEBSTER, JR., draftsman, Douglas Aircraft Co., Inc., Santa Monica, Calif.

GREENE, SYD L., designer, Douglas Aircraft Co., Inc., Santa Monica.

HERMAN, E. S., superintendent, industrial sales, Standard Oil Co. of Calif., Los Angeles.

JENKINS, GEORGE ROSS, vice-president, Allube Corp., Glendale.

JONES, PHILIP HARRIS, design and sales, Bohman & Schwartz, Pasadena.

KAHN, ARNOLD A., tool designer, Lockheed Aircraft Corp., Burbank.

LYTLE, HAROLD A., superintendent, Jones & Harsh, Inc., Los Angeles.

MCCONIHE, PAUL M., lubrication engineer, Seaside Oil Co., Santa Barbara.

MORRISON, GEORGE W., draftsman, Standard Carriage Works, Inc., Los Angeles.

SWANTON, HAROLD R., vice-president, Precision Bearings, Inc., Los Angeles.

SWENSSON, MALTE, hydraulic engineer, Douglas Aircraft Co., Inc., Santa Monica.

Southern New England Section

FERMIER, REX M. A., engine tester, Pratt & Whitney Division, United Aircraft Corp., East Hartford, Conn.

MOLLOY, RICHARD CLAIR, aeronautical engineer, United Aircraft Corp., East Hartford, Conn.

RICHMOND, JOHN LLOYD, engineer, American Bosch Corp., Springfield, Mass.

Washington Section

WHITLEY, LEON E., fleet superintendent, Sunlight Laundry and Cleaning, Inc., Norfolk, Va.

Outside of Section Territory

ANTHES, GARRISON P., president, Anthes Force Oiler Co., Fort Madison, Iowa.

ARMISTEAD, GEORGE, JR., assistant to vice-president, Republic Oil Refining Co., Houston, Texas.

CASEY, EARL L., traveling mechanic, Geophysical Service, Inc., Dallas, Texas.

JORDAN, ALBERT, zone field man, Sealed Power Corp., Muskegon, Mich.

MECHLIN, FRED J., director of laboratories, State of Louisiana, University, La.

SEWELL, JAMES L., general superintendent, Taylor Refining Co., Corpus Christi, Texas.

SNYDER, RAYMOND A., assistant chief engineer, Sealed Power Corp., Muskegon, Mich.

SPEIR, MORGAN B., JR., director of safety, Horton Motor Lines, Inc., Charlotte, N. C.

Foreign

ANDERSON, FRANK, motor engineer, 177 Dowling St., Sydney, Australia.

DOOLE, GEORGE A., JR., senior pilot, Pan American Airways, Aeroporto Santos Dumont, Rio de Janeiro, Brazil, S. A.

LORD, LESLIE EDWARD, assistant works manager, Cooke, Howlison & Co., Ltd., Dunedin, N. Z.

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ability to provide damping of the cushion spring assembly, this function being more important than surface softness in reducing passenger fatigue.

Style of trim and characteristics of the cloth used, particularly its elasticity, are important in overall cushion result, according to these engineers. The degree of elasticity required in the cloth to get most satisfactory results, they said, differs, depending upon whether a plain or pleated style of trim is employed. "Frequently the difference in comfort between an old cushion and a new cushion is largely a matter of the skin tension," they stated, making a plea for the establishment of specifications to be given to suppliers in the matter of elasticity as distinguished from stretch.

Establishing proper seat contour is difficult because a single contour must be made to fit varying physical characteristics of passengers. The free contour is of little importance, the authors emphasized, stressing the actual contour when a passenger is in the seat as the factor of chief importance.

A certain amount of free movement in the seat back, permitting it to follow the passenger vertically, is desirable, they stated, but limiting this movement, to obtain damping of the passenger with relation to the seat proper, is also essential. "More attention should be given to the proper degree of 'float' which is desirable in the seat back," they urged.

A cushion may give a very satisfactory "show-room" softness, the authors stressed, and yet be distinctly unpleasant under dynamic conditions, advocating that cushion design be accepted as a dynamic problem rather than a static one.

Speculating about future developments, they suggested the potential possibility of a leaf type of cushion spring and thought it possible that "we may subsequently find advantage in a means for elastically suspending the seat assembly as a whole with respect to the car body."

They were vigorous in advocating better correlation between chassis engineers primarily responsible for ride development and trim engineers responsible for seat cushions. Every element of seat cushion design has an effect on ride, they contended, and the final "engineering" of seat cushions should not be made a matter for sales department selection.

Discussion

Walter Keys, U. S. Rubber Co., voiced the belief that the stiffness of seat-cushion springs should not increase with deflection and emphasized the inseparable relationship between the two major functions of a seat cushion – the spring and the conforming element. Dr. B. J. Lemon, also of U. S. Rubber Co., pointed out that seat-cushion studies such as Mr. Paton's are even more important in regard to trucks than in regard to passenger cars and expressed the hope that further truck studies would be made. This need was stressed also by Session Chairman John G. Wood.

***Heating, Ventilating and Cooling of Passenger Cars* – HERBERT CHASE, Consultant and Journalist.**

MANY question whether a complete job of air-conditioning passenger cars for all weather conditions can be done at a price which most car buyers care to pay and with assurance that dependable and acceptable results can be guaranteed, Mr. Chase reported in prefacing his comparative study of existing heating, ventilating, and cooling systems. Some 1939 and many more 1940 car models, he said, yield greatly improved results in heating the entire car and ventilating it well with all windows closed, but, he pointed out, the design of such systems is still in a state of flux. He predicted future systems definitely superior to today's average – and probably better than today's best.

Providing detailed descriptions and illustrations, Mr. Chase divided all currently available systems into four classifications for convenient discussion: (1) heating by recirculation only, ventilation incidental; (2) heating in which part of the air is recirculated and part taken from outside and can be heated before delivery; (3) heating in which all air passing through heater is taken from outside; (4) systems which include means for heating, cooling by refrigeration, and at least incidental circulation.

Mr. Chase described and compared current systems in each of the classifications and commented on the problems, advantages and disadvantages involved in each of the designs. He included also comments on structural considerations, mentioning that, except for compressors, valves and a few other somewhat special parts, most of the components of all these systems are produced largely from sheet metal or are die-cast in zinc alloy. "There are many cases," he concluded, "in which it pays to lay down alternative designs for stamping and for die casting, secure comparative costs, and weigh the benefits of each, before deciding which shall be chosen."

Discussion

Meade Moore, Nash chief engineer, and Allen C. Staley, chief engineer, Special Products Division, Chrysler Corp., both emphasized the belief that cooling of passenger-car bodies – though far more difficult than heating and ventilating – is certain to come as existing limitations and problems are finally worked out. The chief problem, Mr. Staley emphasized, is to build acceptable units at a cost which will permit public acceptance.

Mr. Moore said that we still have a long way to go in development of heating and ventilating, despite the major advances of recent years. The ordinary type of car heater, he believes, is due to go the way of two-wheel brakes. Discussing experimental work in connection with car cooling, he said it will be a mistake to try to hold inside temperatures 10 to 15 F below outside temperature. He believes that both heating and cooling systems should provide for the bringing in of some fresh air and said that the air should be directed downward, this being even more important in development of cooling systems than in heating systems.

Mr. Staley said that, in winter with four people in a car, 250 cfm of fresh air is not too much to bring in.

Upstairs and Downstairs Registration Desks Were Busy on the Opening Day

The Automobile Headlamp Problem – **P. J. KENT, Chrysler Corp.**

ALTHOUGH stating that recent improvements in headlighting have standardized and greatly simplified the service and usage problems in the field, Mr. Kent averred that, good though it is, "we still have an optical system which is sensitive to aim and, until such time as the objectionable property of glare can be divorced from the desirable property of illumination, we must continue to face this greatest of all headlighting problems, namely, the aiming of the beam."

Mr. Kent pointed out that there are two distinct phases involved in the headlamp problem – the engineering phase and the maintenance and usage phase. Discussing them, he said: "The patent office records will testify to the amount of mental effort expended on the engineering problem and, so far as headlighting has a bearing on traffic safety, the accident records testify to the neglect of the maintenance, adjustment, and usage problem. Garage mechanics frequently aim headlamps so incorrectly that much of the engineers' development is of no consequence. Owners often will drive with one bulb out, a lens cracked, reflectors tarnished, or will neglect to shift the beams when meeting other cars. It is, therefore, very important that the automotive industry and the motor-vehicle administrators concentrate more effort on the solution of these maintenance and usage problems."

Earlier in his paper Mr. Kent had reviewed the development of the sealed-beam headlighting system which, he said, may take credit for three improvements in automobile electrical systems.

1. Almost universal adoption of the shunt-type voltage-regulated generator with sufficient capacity to carry the full lighting and accessory load without drawing current from the battery.
2. Improvement in car wiring through simplification and larger cables in the headlamp and battery-charging circuits.
3. Improvement in headlamp and beam-control switches through the use of silver contacts.

Taking a look into the future, he appraised the possibilities of polarization. Said he: "This principle offers very interesting possibilities for the ultimate solution of one of the greatest problems in headlighting, but its application presents some difficult problems for which the industry is seeking solution." He then pointed out the nature of these problems – that 90,000,000 polarizing screens would be required for universal adoption of this system; that headlamps with 2½ times the light output of present headlamps would be required to secure the same degree of illumination; that 50 to 65-amp generators would be required, replacing the 35-amp units now in use.

Discussion

In concluding his paper on headlamps, Mr. Kent – who had placed heavy emphasis on the necessity for proper use and aiming of headlamps – made an extemporaneous plea for the cooperation of production, maintenance, and sales people on these two problems. He urged the production men to see that the lamps were aimed properly on the assembly line. He called for the cooperation of maintenance men in securing proper aiming and of sales departments in educating drivers on proper use.

Lee Oldfield, Schwitzer-Cummins Co., said that he believed that technicians understand the headlamp problem, but he is amazed that we make it so complex because he doesn't think there is anything complex about it except our attitude. He stated that the problem had been complicated by reductions in seat heights, by placing headlamps in the fenders and by softer springing. He was critical of the failure of drivers of sealed-beam equipped cars to use their meeting beams and blamed it on a lack of education. During a recent night trip to Detroit he said that he didn't think any of the many driveaways he passed, depressed their lights. He also criticized these lights in the hands of drivers who were not using last year's lamps properly. He said further that overtaking cars do not depress; that many drivers wait until they are over the brow of the hill before doing so. In his opinion, enforcement cannot be depended upon and improvement must be sought through education.

Another discusser said that his experience was that sealed-beam lights gave him better seeing and he felt it was due to the fact that the eye was adapted to a higher level of illumination. He expressed the view that a great deal could be done to cope with glare by raising all light levels on the road.

H. C. Doane of Buick said education is a long process and that we are not going to lick the problem until we take the matter out of the driver's hands. He said that developments now under consideration might provide a practical answer to the larger generator capacity required with polarized headlighting.

V. J. Roper, General Electric Co., pointed out that a miss in aim of as little as one degree made a difference of 10 ft at 600 ft, to illustrate the importance of proper aim. He also said that two beams would be needed with polarized headlighting, one for rural roads and the other for use in the city.

Growing Interest in Direction Signals – **HARRY C. DOANE, Buick Motor Division, General Motors Corp.**

WITH the hope of crystallizing thought on direction signals, with standardization, simplicity, and public acceptance as the final objectives, Mr. Doane stated that the purpose of his paper is to discuss some of the essential fundamentals, with particular reference to the several types of signals that appear to be of current interest.

Stressing the need for direction signals, Mr. Doane said: . . . "all have had the exasperating experience of driving behind the fellow who has failed to lower a window and signal his intention to turn, and the chap who nettles us by wildly waving his arm out of the window, with the final objective of dislodging his cigarette ashes. We, therefore, approach this subject from the interest of public safety as well as of utility . . . the number of accidents attributed to lack of signaling or improper signaling is unquestionably of some significance."

Since the pedestrian must be kept in mind as well as the motorist, signals are necessary at both front and rear of the vehicle; they must be located so that front signals for left and right turns are plainly visible not only to an approaching motorist but also to a pedestrian standing at an intersection; front and rear signals must have sufficient brilliance to be visible for 100 ft in bright sunlight, he specified. The necessity for front signals that must be plainly visible when headlights are on stresses the need for a flashing-type signal, he said.

He then discussed three types of signals of current interest:

1. Signals embodying the use of arrows which may be either of the flashing or non-flashing type.
2. Signals in which the stop lights or other lamps are caused to flash on that side of the car in which the turn is to be made.
3. Illuminated semaphore type mechanically operated and usually intended to be seen from the front and rear. He remarked that they are popular in Europe, but have gained little interest here.

Explaining why a system which could be turned on manually by the driver and turned off by steering-wheel action after completion of a turn, offered the best compromise, he reported that they found that automatic turn-on would operate when the vehicle was passing around vehicles in traffic and thus cause confusion, and that the driver frequently forgot to operate a manual turn-off.

Discussion

Mr. Oldfield said most automotive developments are well engineered, but that the industry does not sell their proper use. He said it was hard to get people to do things for the other fellow. He also raised the question of whether engineers couldn't do a great service by selling the sales people on promoting proper use.

Chairman Critchfield agreed with him on the necessity for education, saying that we can't have signals that think. He also expressed the view that standardization would help both use and understanding.

Commenting on the remarkable color moving pictures Mr. Doane showed of various direction signals, Ray Carlson, Tung-Sol Lamp Works, said they nevertheless didn't give a true picture of the visibility of the signal. He said he felt the automatic kick-off was almost essential and complimented Mr. Doane on the type of indicator used by Buick.

In response to a question from the floor as to why there was not a stronger trend toward amber signals, Mr. Doane said the daylight visibility was not as good. In response to another question regarding signal unit spacing, Mr. Doane said he feels that units at the extremities of the car were most effective. Answering a question on the reliability of the flash, Mr. Doane said it had come through a test of 60,000 switch operations in perfect condition.

PASSENGER-CAR BODY SESSION

I. L. Carron, *Chairman*

A single paper, which brought out vigorous discussion from the floor, comprised the Passenger-Car Body Session, attendance at which exceeded that of any previous technical session of this Activity in many years.

Plastics and Their Uses in the Automotive Industry – **GORDON M. KLINE, National Bureau of Standards.**

ONLY one of the five major plastics developed during the 55 yr prior to 1925 has forged ahead to new records of production and application between 1925 and 1940, according to Dr. Kline. These last 15 years, he showed, have witnessed introduction of more than twice as many new plastic compositions and more than five-fold increase in annual production of plastics. Despite vast gains in the volume of plastics used by the automotive industry, however, there has been little extension in the automotive applications of plastics since 1925, Dr. Kline pointed out. The materials used have changed and vast improvement has been accomplished in the esthetic appeal and durability as well as the economic production of various plastic parts, but advances beyond merely decorative moldings have been chiefly in window frames, glove compartment doors and headlamp shells. "Plastic fenders and a molded body still remain as the greatest prospective field for extension of the uses of plastics in the automobile," Dr. Kline said. Some of the early applications of phenol-formaldehyde plastics in aircraft, he stated, were simply carry-overs from automobile design, although others have grown out of striving to solve new problems.

Bringing up to date in specific, detailed-record form the development, properties, fabrication methods and typical applications of practically every known type of plastic, Dr. Kline recalled some early automotive uses as incidents in his most comprehensive analysis. Cellulose nitrate plastic was used, for example, as windows in early closed models. In the early '20s casein plastic was used for horn buttons, push-buttons and other interior accessories – but has since been supplanted by other types.

Very active development of new plastic materials in the United States started in 1927 with the appearance of cellulose acetate in the form of sheets, rods, and tubes. Such plastics are now used in practically every make of car, Dr. Kline pointed out, the total number of acetate parts involved numbering well over 200. Commenting on attempts to use soybean protein and zein obtainable from corn as raw materials for plastics, Dr. Kline had this to say:

"The hygroscopicity which characterizes casein is an inherent property of proteins in general and before these materials can be molded into useful articles of appreciable size a method or reagent must be found to overcome this defect. Of course, the addition of a high percentage of phenolic resin will accomplish this end, but in such a case it becomes largely a matter of which of two hygroscopic materials, cellulose (woodflour) or a protein, will serve best as a cheap diluent and reinforcing agent for the resinous molding compound. To date, woodflour is the only organic filler commonly used in powders sold on the open market."

Dr. Kline brought out scores of other specific points about the possibilities and adaptabilities of every type of plastic now on the market and included among other valuable specific information lists of the tradenames used by each of the different manufacturers of each of the various types of plastic.

Discussion

Enthusiastic predictions about widened automotive uses for plastics and strong emphasis on the limitations making such expansion unlikely vied with one another in discussion of Mr. Kline's paper.

"Laminated plastics are bound to displace sheet metal in body building," said Dr. M. H. Bigelow, Plaskon Co., emphasizing that "plastics would have assumed a much more important position in the manufacture of cars if the industry as a whole could present to the automotive engineers significant physical data regarding the permanence of plastics."

Herbert Chase, consulting engineer, on the other hand, branded as "absurd" current talk about fabricating automobile bodies from existing plastics. "The limitations as well as the possibilities of extended applications should have practical attention," Mr. Chase urged. He quoted impact strengths of various plastics to show how inadequate they would be for passenger-car bodies and stressed the relative brittleness of some types capable of withstanding the highest impacts.

Dr. Bigelow pointed to the ever-greater number of pounds of plastics being used by automotive manufacturers each year, saying that certain types of plastics will replace to a large extent the sheet metal now being used in car fabrication.

"Unfortunately," Dr. Bigelow said, "the physical data available to the automotive engineer have not been such that he could utilize them in the same manner as the data presented by makers of other raw material such as steel. The net result is that plastics have been used for dressing up the car and have not been seriously considered for certain specifications for which they may be perfectly well suited."

Replying to some of Mr. Chase's criticisms, Dr. Kline agreed that it would not be feasible to mold a plastic body from any existing plastic, but did mention the wider possibilities of plastics with wood or fibrous reinforcement in many applications. Both Mr. Chase and Dr. Kline mentioned, also, the likelihood of still newer plastics being developed which might have properties even more widely applicable than those now in use.

AIRCRAFT-ENGINE SESSIONS

Chairmen

Robert Insley **S. D. Heron**

H. K. Cummings

Attention was focused on one vital topic at each of three stirring Aircraft-Engine Sessions – first spark plugs, then safety fuels and, finally, aircraft diesels. That the results of this intense concentration would contribute outstandingly to the development of safer, more reliable, and more economical engines was obvious to all in attendance.

In the first session – a brilliant symposium on spark plugs – a mixed jury of engine builders, spark-plug manufacturers, airline operators, and service men unanimously sentenced the mica-insulated spark plug to early retirement in favor of the ceramic-insulated type. In a second symposium, on safety fuels, differing opinions as to the relative safety, cost, and thermal efficiency of this type of fuel were aired freely. In the final session the proponents of diesel and spark-ignition aircraft engines, armed with the latest performance data, renewed their debates with vigor.

Ceramic Spark Plugs Re-enter Aviation – **A. L. BEALL, Wright Aeronautical Corp.**

THAT the mica-insulated spark plug has reached the limit of its development in types suitable for high-output aircraft engines, was contended by Mr. Beall, after noting that no major improvements in mica-insulated spark plugs have appeared within the last three years. "The inherent limitations imposed on the designer by the material (mica), as an insulator," he explained, "should protect the spark-plug designer from criticism for lack of ingenuity. It is apparent that other materials might be more tractable."

Discussing these limitations of mica, he explained that mica may be split, wound on an arbor of small diameter, blanked, and stacked; although the edges of stacked laminations may be lathe-turned while the stack is held rigidly, sheets of mica cannot be formed or worked. As a result, he pointed out, the size of the sheet for spark-plug use is limited to an area free from obvious imperfections and consequently the size of the sheet is small. After describing a conventional use of mica insulation in the spark-plug assembly, Mr. Beall reviewed common types of failure inherent in mica-insulated spark plugs, such as stretching or creep of the center spindle, pressure leakage through the core body, and moisture absorption. He speculated that these limitations inherent in the design from the use of mica as an insulator will be exaggerated and emphasized in spark plugs of smaller than conventional size.

A ceramic insulator is the logical choice as the substitute for mica, Mr. Beall averred, in that the material chosen may have most of the desirable dielectric characteristics of mica while offering a dense, homogeneous structure in contact with combustion gases. Also, he continued, if the insulator is well designed, thermal expansion of the spindle does not present serious difficulty.

Citing test experience Mr. Beall brought out that the ceramic spark plug has a better preignition rating, that it may be molded to shape in one piece, and that it is opaque to radiant heat.

The Shortcomings of Mica as an Insulator Material in Aviation Spark Plugs – **VAL CRONSTEDT, Pratt & Whitney Aircraft, Division United Aircraft Corp.**

THE enormous number of spark plugs that are required to keep an airline operating smoothly appears to be a powerful indictment against the present spark-plug design, Mr. Cronstedt contended. The maintenance records of one coast-to-coast air line, he reported, show that, for a collective total of 5350 flying hr selected at random, the number of *unscheduled* plug replacements reached the astonishing figure of 2187 among a group of some 60 odd engines. On the other hand, Mr. Cronstedt pointed out, the spark plug is the place where any ignition trouble first shows up, by its failure to ignite the charge. Thus, he continued, it is very likely that the spark plug many times is blamed for defects in the magneto or current-distributing system when the trouble may not be seated in the plug at all. True enough, he added, a new plug may momentarily, and frequently does, rectify a defect existing in the wiring, or even in carburetion when no part of the ignition system is at fault, that will show up again as the plug becomes older and the gap increases or its insulating resistance is decreased.

At any rate, he reported, records of American air-transport activities show that between 80 and 90% of the schedule interruptions caused by the engine itself have their source in ignition trouble (40 to 60% of schedule operations due to mechanical reasons).

In general, Mr. Cronstedt's paper dealt with the reasons for adopting mica as a spark-plug insulator and its ultimate failure as demands on reliability and engine performance increased. He detailed the mechanical make-up of an aviation spark plug, the role that mica plays in the assembly, and its inability to function properly because of its characteristics.

Ceramic Insulators for Spark Plugs – **F. H. RIDDLE, Ceramic Division, Champion Spark Plug Co.**

THE word "ceramic" is derived from the Greek word "keramos" meaning "burned stuff," thus indicating its inorganic character, Mr. Riddle explained. Although the word is commonly associated with the substance known as clay, he continued, in modern usage it includes a large number of minerals and rocks and a correspondingly large number of mineral products, such as the many clay products, glass in its many forms, enamels, and the cements. The chief actors on the stage of ceramic insulators, he indicated, are the silicates, especially the silicates of aluminum.

Taking up clays first in his discussion of ceramics, he showed that clays differ enormously in their physical properties chiefly because of differences in mineral structure, particle size, and the impurities associated with them because of their geological history. Quartz, feldspar, porcelain, and spark-plug porcelain also were treated in his presentation. He showed that spark-plug glaze has a surprising effect on the physical properties of the insulator.

Mr. Riddle then listed and discussed some of the properties which are involved in the performance of spark plugs: density, porosity, and refractoriness; mechanical strength; thermal expansion; electrical resistance and other electrical properties; thermal conductivity; resistance to heat shock; and resistance to chemical agencies.

"The ceramic should be considered as a raw material to be used by the spark-plug engineer the same as he would use any other raw material. It has been shown that the characteristics of the ceramic vary widely, and the spark-plug designer must necessarily know and use insulators best suited for his requirements," Mr. Riddle summarized in conclusion.

Discussion

Both speakers and discussers voiced surprising agreement on two points: that mica-insulated aviation spark plugs must soon give way to the more reliable ceramic types and that the spark plug often has been blamed for failure in other parts of the ignition equipment of aircraft engines, as well as for carburetion troubles.

First to rise in discussion was Harold E. Gray, B. G. Corp., who gave information from airline operation to supplement and confirm that given in Mr. Cronstedt's paper and assigned reasons for the airlines' criticism of spark plugs. In a review of airline complaints, he reported that only 7% of the spark-plug complaints were justified and that only 1¼% of the spark plugs examined were found to be the cause of the complaints. If an engine was rough and a spark-plug replacement smoothed it out, he told of his difficulties in selling the crew the idea that the spark plug was not solely to blame for the roughness. "We found that the connecting link, the ignition harness, was responsible for most of the complaints," he asserted. To test the ignition harness on the engine, a special test set was used, he said.

H. K. Cummings, National Bureau of Standards, next gave his views on the three papers presented. Especially in high-output engines, he believes, should ceramic spark plugs come to the relief of the mica-insulated type. He said that he was glad to see Mr. Cronstedt give credit to the mechanical developments that allowed the mica spark plug to get as far as it has. With reference to Mr. Riddle's paper he asked for further information on the construction of single-oxide bodies, requesting a list of the single compounds considered for spark-plug application.

The seriousness and magnitude of the spark-plug problem to the airlines brought out by other speakers were emphasized by R. D. Kelly, United Air Lines Transport Corp. "United Air Lines," he reported, "is spending more money each year for new spark plugs than for oil." He added his agreement to the claim that a lot of trouble is blamed on spark plugs not caused by them. He expressed his concern about the possibility of spark-plug failure in high-power high-temperature operation, especially when a two-engine plane is required to go on single-engine operation.

What we need, he pointed out, is an improved plug more consistent in its operation throughout – a plug that can be counted on 100% of the time.

Air Corps experience with ceramic-insulated aviation spark plugs was reported by Thomas Neill, U. S. Army Air Corps. The problem of gas tightness, he said, is not serious if the plug is designed properly. Today the engine builders and spark-plug manufacturers are working together, he pointed out, but, in the past, the engine builders were so wrapped up in engine design that they first designed the engine and then asked the spark-plug manufacturer for something to fire the charge. However, he added, more engine testing by the spark-plug manufacturers would help solve the problem.

Charging that the ignition methods of the airlines are "somewhat crude," he suggested that, if at the time spark plugs were suspected the cores were tested for leakage, spark-plug difficulties would be alleviated. For harness leakage he recommended a magneto set-up to load the cables electrically. He urged that it is better to remove and check all spark plugs from an aircraft engine rather than only those suspected of causing trouble. In conclusion, he echoed that they have been unable to obtain any mica spark plug that has "what it takes."

Pointing out that his company makes both mica and ceramic spark plugs, E. S. Twining, Champion Spark Plug Co., reported that porcelain spark plugs have succeeded the mica type for racing automobiles at the Indianapolis speedway. In answer to Mr. Neill's plea for more engine testing by the spark-plug manufacturers, he announced that his company operates both high-speed and regular CFR test engines as well as the Wright air-cooled cylinder. To Chairman Insley's request for information on what has been, and what can be, done with ceramic-insulated aviation spark plugs, he assured him that this information could be expected in the not-too-distant future.

With reference to Mr. Gray's comments about the percentage of failures actually attributed to the spark plug itself, Mr. Beall stressed the point that a single crater failure of a mica spark plug resulting in dehydration of the mica and temperature rise may be of vital importance to the safety of the airplane, even though it happens relatively infrequently. Expressing agreement with Mr. Cronstedt, he voiced the hope that there would be fewer types of spark plugs to test in the future and that those types would hold more promise.

In their rebuttals, Mr. Cronstedt endorsed Mr. Neill's statement that the spark-plug manufacturers should do more en-

gine testing and Mr. Riddle told Mr. Cummings that the glaze mentioned is used more on the terminal end than on the cylinder end, and that it is necessarily made to flux to a glass.

Alkylation as a Source of "Safety Fuels" – DR. RAYMOND HASKELL, The Texas Co.

THE alkylated form of safety fuel has been run in test engines in comparison with other forms of high-octane fuels, using direct cylinder injection, and it has been found that there is no difference in power and efficiency between the safety fuel and gasoline, Mr. Haskell reported. The principal problem of course, he continued, is the difficulty of starting in cold weather, adding his opinion that it will be solved shortly.

"Alkylation," he explained, is a process, with or without catalyst, by which certain definite types of hydrocarbons containing alkyl side chains are formed by the interaction of two or more hydrocarbons, generally of a rather specific nature. It is akin to polymerization or condensation, he continued, and indeed can be considered a specific case of the latter general reaction. Since it has been known for some time that there are compounds above the gasoline boiling range that have good antiknock value, he said, the problem, as far as the oil industry is concerned, is to find a way to make these compounds in quantity and at a reasonable price.

With regard to quantity Mr. Haskell announced that there is now in operation, under construction, or seriously contemplated sufficient capacity to make 15,000 bbl a day, or 200,000,000 gal a year. Further expansion, he indicated, depends only on demand, stating that there is no limit to the number of production units that can be installed if the raw materials are available. "If the raw materials give out," he added, "we know ways of making them." In concluding he assured his listeners that the price of alkylated safety fuel will be within reason and, as soon as some reasonable definite figure of demand over the next five years can be determined, that natural competition will bring the price to a level which the aviation industry can well afford to pay.

Safety Fuels by Catalysis – W. M. HOLADAY, Socony-Vacuum Oil Co.

EQUIPMENT is now available for the production of large quantities of aromatic-type safety fuels, Mr. Holaday revealed. These fuels, he continued, can be diverted to special use by the installation of facilities for separating the desired stocks in the refineries and establishing a distribution system. The cost of these fuels, he believes, will be comparable to that of aviation gasolines of equal octane number, provided specification requirements do not necessitate special equipment for manufacturing and handling.

"Aromatic safety fuels," Mr. Holaday explained, "is the term applied to fuels in which the majority of the material present is of aromatic type. Depending on the method of manufacture, the safety-fuel cut of aromatic or partially aromatic type may contain from 20 to over 90% of aromatics. Safety fuels produced by catalytic cracking and distillation only, without further processing (such as solvent extraction, acid treating, and so on) contain about 30% aromatics." Generally speaking, he said, as the aromatic content increases, the clear octane number will increase, but the lead response will diminish. Since tetraethyl lead will probably be used in the fuel, he pointed out, the lead response is an important factor.

With the recent introduction of the catalytic cracking method, a method is now available which will provide for the production of aromatic-type safety fuels with an octane number above 85 on a large scale, he announced. This method, he qualified, is not of material value in making available safety fuels of 100 octane number or higher.

Discussing heat of combustion, Mr. Holaday reported that catalytically cracked safety fuels containing about 30% aromatics have been found to have a calorific value 1½ to 2% lower than purely paraffinic fuels of 300 to 400 F boiling range.

Availability and Characteristics of Aviation Safety Fuels – ROBERT E. ELLIS and W. J. SWEENEY, Standard Oil Development Co. (Presented by Mr. Ellis)

SO great is the interest in the development of safety fuels at the present time that engine designers should consider seriously the production of engines which will operate on the most economical safety fuels, the authors maintained. The purpose of their paper, they announced, is "to present one fuel manufacturer's viewpoint on this subject so that the engine manufacturer and ultimate users of engines and fuels may direct their efforts along lines of assured fuel availability and reasonable costs."

Comparing aromatic and paraffinic safety fuels of high octane number, they showed that the aromatic type is immediately available from selected crudes through the application of proved methods of solvent extraction; that such aromatic supplies can be augmented by hydrocarbon conversion processes; that the paraffinic type is not available in any presently known crude oils and will, of necessity, be 100% synthetic products; that the paraffinic type has a calorific value per lb 6 to 7% higher, but that the calorific value per gal can be 8 or 9% in favor of the aromatic type; that there is little difference indicated by performance tests; and that aromatic-type fuels appear to have a higher auto-ignition temperature than paraffinic fuels of a given boiling point.

In their conclusion they emphasized that safety fuels can be made available in very substantial quantities and that the price of these fuels will depend upon the specifications finally decided upon and the consumer requirement.

Discussion

D. P. Barnard, Standard Oil Co. (Ind.), was first to give his views on these three papers. If, as Mr. Holaday points out, he reasoned, only 35% of the catalytically cracked safety fuel is aromatics, the remainder must be paraffinic or naphthenic or the knock rating would be higher. He argued that some other material must go with the 35% aromatics to raise the octane number or to preclude heat loss. Dr. Haskell's observation that the equipment necessary for alkylated safety fuel requires five years to amortize shows the faith the petroleum industry has in the aircraft industry, he pointed out.

Before high-flash fuels come into general use, Dr. Barnard contended, the economic desire to use them must balance the cost of making them. We cannot sacrifice anything in octane number or other properties, he continued, that will reduce the revenue carrying load. An economic valuation of the whole problem is necessary, he brought out, asking: "Must the safety fuel satisfy all other requirements plus high flash?" If so, he continued: "How much more is the aircraft industry willing to pay for it?" If not so: "How much of an octane-number penalty is the aircraft industry willing to take to get high-flash fuel?"

"In my opinion," he declared, "the aromatic type of safety fuel is now 'behind the eight ball' unless it demonstrates some characteristics in actual service that we do not now suspect."

"The term, 'safety fuel,' should be used with caution until its unqualified implications are verified," warned A. L. Beall, Wright Aeronautical Corp., in prepared discussion. While it is necessary to agree with Messrs. Ellis and Sweeney that, for the present, specifications for low-volatility fuel should be limited as much as possible, Mr. Beall went on, the calorific value and lead susceptibility should be included. The calorific value of the fuel undoubtedly affects engine thermal efficiency directly, he pointed out, and the lead susceptibility of the fuel indicates what may be possible for the future in the way of increased compression pressures through the use of higher knock-value fuels.

The comparison of aromatic and paraffinic hydrocarbons seems to be similar to that for bituminous and anthracite coal, Mr. Beall continued. For a static powerplant with cheap transportation and fuel, excellent results can be obtained from the lower calorific value bituminous coal. If fuel transportation costs were high and relative calorific values became important, anthracite undoubtedly would have first call, he averred.

The volume calorific value of fuels is of little interest as the engine responds only to the heat units available in a given *weight* of fuel charge, he contended. The commercial acceptability of highly aromatic fuels will be dependent on their thermal usefulness, he declared, pointing out that a penalty of 6% in calorific value per lb on one long flight would reduce the payload by 800 lb, or more than $1000 in revenue.

We have been asked: "Why aren't we using safety fuel?" contributed R. D. Kelly, United Air Lines Transport Corp. "In the first place," he explained, "we can't get it and, if we could, we have no engines in which to use it. However," he added, "we are interested in safety; since our last fatal accident in regular scheduled operation our ships have flown over 700 million passenger-miles. We realize that, although few, some fatalities could have been avoided by the use of high-

boiling-point fuels. We are also interested in efficiency," he went on; "we know that a slight loss in heat value of the fuel can cost very much."

Starting is another point that causes some concern, he noted, adding that reports of diesel operation in Europe indicated difficulty in starting. He also brought out that a high-flash fuel should eliminate the danger of fire when servicing equipment on the ground and that price also is important as fuel represents the largest single item of airline expense.

The question: "How safe is a safety fuel?" was brought up at this point by Major J. H. Doolittle, Shell Oil Co., who stated his belief that qualitatively safety fuel is much safer than aviation gasoline. He reported that recent tests have proved that a 400 to 500 F cut can be made that will permit a 100-octane fuel to be produced from it by the addition of lead. Safety fuel of 100 octane number costs 50¢ per gal and, of 95 octane number, 30¢ per gal, he quoted. This fuel is available, he announced, and will continue to be available in any quantity the industry may require.

Full-scale test results in which "safety-fuel performance was definitely inferior to that of 80-octane gasoline" were revealed by one discusser. With the safety fuel, fuel consumption was higher and output lower, he explained. "As practical engine builders," he concluded, "we are faced with the question of what is going to be justified by the result."

No fuel is really safe, only relatively so, emphasized R. C. Alden, Phillips Petroleum Co. He wondered whether those pointing out that aromatic fuels weigh more than others would ask a proportionate price.

Commenting on Mr. Kelly's remarks Dr. H. C. Dickinson, National Bureau of Standards, wondered how many of the airlines' fatal accidents involved fire and how many involving fire could have been avoided by the use of safety fuels. Under many operating conditions with safety fuel, he pointed out, there may be an explosive mixture over the fuel. If some one would make a "brutal" analysis of how much safety fuel costs per fatality, he suggested, we would get somewhere.

The Performance of Modern Aircraft Diesels – **PAUL H. WILKINSON, Consulting Engineer.**

A DEFINITE future exists for air-cooled, 4-stroke aircraft diesel engines in the 400 to 600-hp class; an up-to-date air-cooled 4-stroke aircraft diesel could compete on a basis of parity with an 87-octane gasoline aircraft engine, and in all probability with engines operating on 90 and 100-octane gasoline in the 1000 to 1200-hp class; the aircraft diesel is at least on a basis of parity with the gasoline aircraft engine in the 1000-hp water-cooled and liquid-cooled high-performance class, and that since the diesel can be conveniently fitted with a turbo-supercharger, there are definite advantages to be derived from the use of a 2-stroke diesel of proven worth. These conclusions, made by Mr. Wilkinson, were based on comparative tables presented in his paper.

Mr. Wilkinson, who last year visited diesel aircraft centers in France, Germany, England, and the United States, opened his paper by commenting on a dozen or more slides showing modern diesel-powered airplanes being flown in these countries. He commented on the advantages of diesel aircraft engines, grouping them as: economic advantages such as reduced fire hazard, low fuel operating costs, and large payload and flight-range possibilities; and mechanical advantages such as reliability and efficiency.

Mr. Wilkinson paid tribute to the work which has been accomplished in the field of aircraft diesels in the United States, and urged more encouragement to pioneers in the field, and better distribution of aircraft diesel information and ideas. He suggested that the veil of secrecy which now envelops aircraft diesel projects in the United States be removed for the benefit of a new industry, and that the SAE should establish a separate aircraft diesel activity to promote interest and discussion in this specialized branch of engineering.

Discussion

That the aircraft diesel picture is not as bright as was pictured by the author was an almost unanimous view of men answering Chairman Cummings' call for discussion. There was no controversy, however, on Mr. Wilkinson's plea for continued development of the diesel for aircraft.

Arthur Nutt, Wright Aeronautical Corp., had prepared discussion in which he challenged some of the author's basic data on gasoline engines as obsolete, and, by substituting more recent data from sources that he believes reliable, showed that the diesel aircraft engine has not so nearly approached gasoline engines in performance, specific weight, or specific output, as contended by Mr. Wilkinson. He also suggested that there is less saving in fuel costs by diesels than the author intimated.

Mr. Nutt mentioned progress in the development of safety fuel, the use of which will overcome to a great degree the objection which the author raised to the use of highly volatile fuel in aircraft. He also pointed out that some of the worst fires have been caused by lubricating oil rather than gasoline.

The prime reason for interest in diesel engines by the German Government, he stated, is the lack of proper fuels to operate gasoline engines. In spite of this fact, Mr. Nutt continued, all of the latest high-performance German military aircraft are fitted with gasoline engines, and will continue to be so until such time as the diesel engine can measure up to gasoline-engine performance.

Interest was expressed by Robert Insley, Pratt & Whitney Aircraft, in the photo shown by the author of a German diesel aircraft squadron, and he asked Mr. Wilkinson how many such squadrons there are in the German Army. Mr. Insley commented on the number of estimated weight references in the paper, and stressed the difficulty of making such estimates with accuracy by stating that he even questions those made by his own designers. Also brought out by Mr. Insley was the fact that, in the aviation industry, engines built for 87-octane fuel are considered obsolete.

Mr. Wilkinson's data on fuel for compression-ignition engines were contested by A. L. Beall, Wright Aeronautical Corp. Despite the volume of apparently successful flight operation of supercharged aircraft engines with byproduct fuels, Mr. Beall contended, the day-by-day experience of operators of naturally aspirated engines shows that, even at these extremely moderate brake mean effective pressures, there is a very definite gum problem. If the aircraft compression-ignition engine is to compete successfully with the gasoline engine in usable horsepower hours, Mr. Beall declared, its proponents must recognize the necessity of using fuels as well refined as the best aviation gasolines. This, he said, is a prediction.

He referred to water-white kerosene as a suitable fuel, and noted that there is a limited supply; that it is sensitive to demand; and that, once the price has to be based upon new refining operations to make it, the price will skyrocket. In comparisons of fuel prices to more nearly fit the prospects, he stated, the fuel cost per gallon for diesel fuel should be identical with that of 100-octane gasoline.

A compromise was suggested by James B. Fisher, Waukesha Motor Co., who asked: "If spark plugs have been so efficient in igniting gasoline, why throw them in the alley when we want to burn cheap fuel?" He said that there are misconceptions about the necessity of high compression ratios for high brake thermal efficiency, and declared that the compression ratios can be lowered considerably by the use of spark ignition.

Dr. George Lewis, National Advisory Committee for Aeronautics, explained the NACA interest in diesels. The Navy, he said, wanted to take all gasoline off ships. As some of the cruisers carry airplanes for spotting purposes, this diesel work was undertaken. The NACA, he added, is not prejudiced for or against diesel or gasoline engines. He feels, however, that the diesel has "a hard row to hoe" against the gasoline en-

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gines which are lowering consumption and are getting higher octane fuels and safety fuels.

The aircraft diesel engine using 55-cetane fuel is history, stated D. P. Barnard, Standard Oil Co. (Ind.), who added that it is a long-standing fallacy that diesel fuel is as cheap as dirt.

Prof. P. H. Schweitzer, Pennsylvania State College, suggested that some of the author's power-output curves did not concur with laboratory tests as they continued upward instead of flattening at the top. The diesel engine, he believes, has a good future in aircraft – particularly when 3000-hp powerplants will be demanded. Fuel storage is an acute problem aboard warships, and use of the diesel might solve it, he added.

Summing up, Mr. Wilkinson quoted authorities for the questioned data. On the subject of fuel he contended that a good quality furnace fuel cleaned effectively with filters would be satisfactory. It may be warmed slightly by the engine to obtain a better pour point, he added.

Withdrawal from this session of the paper by J. J. Broeze, L. A. Peletier, and H. Van Driel, N. V. de Bataafsche Petroleum Maatschappij, was noted by Chairman Cummings, who reported that its contents could not be revealed at this time.

Upon very short notice, Mr. Cummings continued, R. F. Gagg, Wright Aeronautical Corp., had prepared a brief discussion of the "Current Status of Fuel Performance Tests in Aviation Engines." He then introduced Mr. Gagg.

Current Status of Fuel Performance Tests in Aviation Engines* – R. F. GAGG, *Wright Aeronautical Corp.

WARNING that results of tests on single-cylinder engines are sometimes grossly misleading because of unavoidable dissimilarity in the single and multicylinder engine operation, Mr. Gagg stated that the single-cylinder unit should properly be used only as a sort of pilot for full-scale testing until the results of the two kinds of tests are in substantial agreement and are validated by the final arbiter – experience in service. Short cuts from this path, he continued, have led a few aircraft operators into serious service difficulties. For the present at least, he contended, full-scale multicylinder engine tests must be counted as the most reliable guide for action.

Mr. Gagg referred to the procedure developed by Cooperative Fuel Research groups for detonation rating tests of fuels in aircraft engines as quite satisfactory for measuring fuel characteristics at cruising power levels where fuel consumption is the governing consideration. However, he added, it seems clear that no fuel test or comparison at a single power-output level can provide all of the information needed to judge its qualities for take-off operation. A take-off rating test for fuels, he contended, must be added to the CFR fuel-rating procedure, so that engine builders may take full advantage of all desirable fuel characteristics, and fuel producers may have their products justly appraised and properly used by their customers.

Mr. Gagg stated that a take-off detonation-rating test must demonstrate maximum power output permitted by fuel characteristics, and freedom from overheating of the engine. He then outlined proposed procedures.

Discussion

Discussion of Mr. Gagg's presentation centered around the possibility of adopting bi-fuel systems providing different fuels for take-off and cruising, and the use of aromatic fuels. Participating in this discussion were S. D. Heron, Ethyl Gasoline Corp.; Earle A. Ryder, Pratt & Whitney Aircraft; A. L. Beall, Wright Aeronautical Corp.; D. P. Barnard, Standard Oil Co. (Ind.), and the author.

AIRCRAFT SESSIONS

Chairmen

Charles H. Colvin **Peter Altman**

Solutions for four of the most troublesome problems in the design and operation of aircraft were sought in the two Aircraft Sessions. In the first many joined in the hunt to track down the source of corrosive impurities found in aluminum fuel tanks and debated various means advanced for controlling a four-engine airplane after a failure of one or two engines at take-off. Fundamental test and flight data on engine cowl surface pressure that will insure against cowl failure and a scientific method for correlating wind-tunnel and flight-test results of a new design, were criticized constructively in the final session.

Aluminum Aircraft Fuel Tanks **– E. H. DIX, JR., and DR. R. B. MEARS, Aluminum Co. of America. (Presented by Dr. Mears)**

BECAUSE of advantages of light weight, ease of fabrication, and high resistance to corrosion, aluminum aircraft fuel tanks have been used widely for two decades, the authors pointed out. Although it was established many years ago that dry gasoline does not corrode aluminum, they reported that pitting of the aluminum shell has occurred sometimes in the presence of badly contaminated water. One of the most important factors which influence the amount and nature of the water which is present in the tank was named as the extent with which this water is contaminated with iron rust and corrosion products of other metals with which it has come into contact during the handling of the gasoline from the refinery to the plane. In these isolated cases of corrosion in aluminum aircraft fuel tanks, the evidence indicates that the corrosion was caused by such water, contaminated with chlorides, bromides, or heavy metal compounds, lying in the bottoms of the tanks for extended periods, they said.

This corrosion, they explained, can be prevented by: designing tanks to permit free drainage of water to the sump; selecting metals to avoid electrolytic action; handling fuel so that it will not pick up water, iron rust, or other heavy metal corrosion products prior to the time that it is introduced into the aircraft fuel tank; applying suitable coatings to the aircraft interior; the use of Alclad sheet; employing corrosion inhibitors either in capsules inserted in the tank or as an addition to the fuel; and by periodic cleaning of the tank interiors or flushing them with inhibited solutions.

However, they cautioned in conclusion, it will be necessary to obtain further information before it will be possible to determine just which of the protective measures could be employed most economically in any given case.

Discussion

Discussion was featured by an attempt to spot the source of the chlorine compounds found by authors in the water which, in some cases, collects in aluminum aircraft fuel tanks, and sometimes causes corrosion. The subject was brought up when A. L. Beall, Wright Aeronautical Corp., took issue with the authors' statement: "It is understood that aviation fuels occasionally contain some ethylene dichloride." In reply, Dr. Mears conceded that he was not sure that any aviation gasoline contained this component. Another discusser suggested that the source might be rain water – that raindrops contain the harmful chlorides.

Answering Prof. Peter Altman, University of Detroit, who inquired whether the chlorides were found in the welded or riveted tanks, suggesting that the impurities might be caused by unremoved flux, Dr. Mears reported that, in some cases, the chlorides did come from welded tanks. A similar point was brought up by John G. Lee, United Aircraft Corp., who brought out that some corrosion difficulties in brazed aluminum fuel tanks might be traced to the brazing flux. In answer, Dr. Mears emphasized that care is taken to get the flux out and that, although similar, the brazing problem was greater than that of welding. Dr. Mears expressed his agreement with Mr. Beall's contention that several of his recommended preventives have been known for some time, except in the case of "designing tanks to permit free drainage of water to the sump." Only in some ships, he averred, are tanks so designed; in many others it is impossible to get the water out.

It does not appear to be necessary to treat Alclad anodically for fuel-tank use, especially Alclad 24ST and 17ST, Dr. Mears replied in answer to a question by T. P. Wright, Curtiss-Wright Corp., adding, however, that it might be desirable under certain extreme conditions.

Rudder Control Problems on Four-Engined Airplanes **– CLARENCE L. JOHNSON, Lockheed Aircraft Corp. (Presented by Prof. M. J. Thompson, University of Michigan)**

THREE ways to solve the problem of controlling a four-engined airplane after a failure of one or two engines at take-off were advanced by Mr. Johnson when concluding his paper: increasing the vertical tail area; holding the airplane on the ground until control speed is reached; and coupling symmetrical engines together so that the failure of one engine reduces the power on the opposite one to less than take-off power.

Earlier in his presentation Mr. Johnson showed that this problem becomes increasingly serious as the airplane power loading is reduced. "Fortunately," he pointed out, "the trend of normal design now existing is such that the wing loading is also increasing so that the difference between the take-off speed and the control speed with one engine inoperative does not change greatly." A serious problem is presented by the use of flaps on take-off from the point of view of rudder controllability of these four-engined planes with one or more engines inoperative, he averred.

It is impractical, Mr. Johnson believes, to provide enough vertical tail area to control the airplane by allowing a certain angle of yaw without depending upon the pilot's reaction to apply the proper amount of rudder. He showed that a fortunate condition exists in that, as the power loading decreases, automatic engine controls can be used to limit the power of the unsymmetrical operating engine to the point where ample controllability can be obtained. He assured his listeners that a satisfactory margin of climb performance will still remain on airplanes of modern design, and that, by use of such automatic features, take-off flap settings may be used without sacrifice of take-off safety due to engine failure.

Discussion

One more way to control a multiengined plane after engine failure at take-off was advanced by T. M. Hemphill, Consolidated Aircraft Corp., in written discussion read to the session by Prof. Altman. "Our experience has been," he said, "that the slipstream which produces the high-lift effects referred to in Mr. Johnson's paper also can be directed on to the vertical tail surfaces so as to counteract the moments due to engine failure." This can be done, he explained, either by toeing out the engines or toeing in the vertical surfaces. It is conceivable in a four-engine airplane with a triple tail, he continued, that the two outboard engines could be toed out so that their slipstream would be directed on the outboard surfaces while the inboard engines can be directed at the center fin with satisfactory results. This would avoid the necessity of reducing power and also for the mechanism required to accomplish the power reduction, he pointed out.

In verbal discussion many voiced their objections to Mr. Johnson's recommendation to reduce the power on the opposite engine when an engine fails during take-off. Calling this method a "doubtful expedient," Mr. Lee contended that, under certain conditions, such a safety device might increase the hazard. Ralph H. Upson, in emphasizing the high-lift effect of slipstream operation, compared the problems in planes equipped with conventional and pusher propellers.

That the conditions are more severe than Mr. Johnson has indicated, was the opinion of one discusser who stressed the extreme rapidity necessary to overcome yaw that starts with engine failure.

"If, as Mr. Johnson points out, the desirability of cutting power off depends on power loading, where are power load-

ings likely to go?" asked Mr. Wright. He then stated his opinion that power loadings might go from 15 to 10 lb per hp, but were unlikely soon to go lower than 10 lb per hp. He agreed that power cut off was bad with high power loadings, but would be satisfactory at a power loading of 8 lb per hp.

"We don't want to ask our pilots to cut power," was the reaction of R. D. Kelly of United Air Lines to the problem under debate. "We found out with two-engine airplanes," he recalled, "that we had to take the precaution of getting up to single-engine speed before the plane is taken up. According to the problems brought up today," he declared, "it seems that we are still faced with the possibility of getting up to high speed before taking off."

A question as to the feasibility of feathering a "sick" engine at take-off brought two answers. Mr. Wright argued that there is no question that feathering is advantageous, but that the time element involved militates against it. Mr. Kelly brought out that, in airline operation, the pilot does not like to have a "sick" engine and propeller "feathered on him" because he may still be able to get something out of the disabled engine. He would rather do the feathering himself if necessary, he concluded.

Air Forces on Radial Air-Cooled Engine Cowling as Determined from Pressure Distribution Tests – R. R. HIGGINBOTHAM, Republic Aviation Corp.

THE purpose of his paper, Mr. Higginbotham explained in his introduction, is to discuss some of the factors influencing engine cowl surface pressures; to present and analyze the results of pressure tests on one cowl model in the wind tunnel and on three representative cowl designs in flight; and to suggest methods of applying pressure-distribution data to the stress analysis of other cowls. These things he proceeded to do. The flight-test data presented, he stated, were taken from test reports of the United Aircraft Corp.

The structural design of an engine cowl, he pointed out, is a matter of considerable importance. The failure of the cowl or its supports, he explained, may not only result in the loss of the cowl, but the propeller and the engine may be damaged badly and the cowl parts may be blown so violently against the wings or tail surfaces as to damage them beyond the possibility of a safe landing. Because continued improvement in airplane speeds and the increased severity of tactical maneuvers have increased greatly the aerodynamic forces on the cowling, the need for data from which to calculate these air loads has become increasingly imperative, Mr. Higginbotham averred, especially for certain military types which are required to execute terminal velocity dives.

Among the 12 conclusions reported by the author are that the aerodynamic forces were higher with power off than with power on for the cowls tested; that the largest forces occur at the lowest conductivity of the engine-baffle combination; that the most severe cowl forces occur at the largest angle of attack obtainable at maximum velocity; and that the surface pressures on an engine cowl without propeller are proportional to the dynamic pressure of the free air stream for non-turbulent external airflow when local velocities are below the speed of sound and the conductivity of the engine-baffle combination is independent of air speed.

Discussion

Asked for information on the condition that exists at the critical speed for engine cowling, Mr. Higginbotham replied that the critical speed varies with the form of engine cowling, and that the shock wave does not develop until the speed is above 400 mph. The tendency of the propeller effect is to increase or decrease speed of air at all sections, he told T. P. Wright, Curtiss-Wright Corp.

Chairman Altman contributed two questions to the discussion at this point. He wanted to know whether the baffling was considered tight in the results with the flaps open and what was the effect of an obstruction such as a windshield in single-engine planes. Mr. Higginbotham replied that the conductivity was quite low in the tests and the effect of body shape was taken into account. "To my knowledge there are no published data on the cowling pressures of in-line engines," he told another discusser.

The Correlation of Wind Tunnel and Flight Test Results – W. W. SYMINGTON, JR., The Glenn L. Martin Co.

THE only available means of accurately predicting the final performance of a new aircraft design is the accurate correlation of wind-tunnel and flight-test results, Mr. Symington explained in his introduction. He emphasized the importance of such a correlation by declaring that, at present, large contracts may be dependent solely on the guarantee that a company is willing to make.

Engine power, propeller efficiency, and drag were named as the three major factors entering into the coordination of wind-tunnel and flight-test results. Of these Mr. Symington said: "The real problem is to predict the performance consistently beforehand, and this can be done only when the power, propeller efficiency, and drag used in the calculations are the same as those obtained in flight."

Of these three major variables he contended that drag has the greatest influence in determining the final performance of the airplane. He then divided this drag into two parts – the drag items not included in the wind-tunnel tests and the drag determined by the wind-tunnel tests, and discussed the latter wind-tunnel drag, which he believes the more important, with its relation to turbulence and Reynolds Number. For the smaller tunnels, he suggested that a screen be used to place the model results in a fully turbulent Reynolds Number region where the skin-friction laws are relatively accurately known. Once the model is in the fully turbulent region, Mr. Symington showed how a logical formula can be derived by extrapolating from test to full-scale Reynolds Number. He derived this formula for three sets of wind-tunnel tests, and showed how the values for two models coordinated with full-scale high-speed flight.

Although stating that airplane speed has been the all-important factor in the present system of competitive bidding, he announced that rates of climb and absolute ceilings have been computed for the two demonstration airplanes, and that the results obtained were within flight-test accuracy for both models.

From an analysis of results, Mr. Symington concluded that, the more individual items separately justified, the more nearly perfect the coordination.

Discussion

Quoting figures from Mr. Symington's paper to back his point, R. L. Bayliss, Consolidated Aircraft Corp., declared: "Apparently the extrapolation to full-scale Reynolds Number cancels out and does not affect the results finally obtained." His prepared discussion was read by Prof. E. A. Stalker, University of Michigan. Experience with models tested in the California Institute of Technology 10-ft wind tunnel at a Reynolds Number of 1,600,000 has shown that extrapolations for Reynolds Number are very unreliable and misleading, he contended. "Consequently," he continued, "we have neglected them and have consistently obtained good results by empirical corrections to the wind-tunnel data, based on flight-test and Galcit wind-tunnel data."

Mr. Bayliss' claim may be true for that particular wind tunnel, Mr. Symington pointed out, but we have found that transition points change in various tunnels. He then told of his experience with the problem in a number of tunnels.

"The accuracy with which Mr. Symington's flight-test results agree with the estimates is so remarkable that it almost appears coincidental," opined Adolph Burstein, Barkley-Grow Aircraft Corp., in written discussion read by Jerome McBrearty of the same company. Pointing out that recent NACA reports have published the opinion that free atmosphere is relatively free of turbulence whereas the tests are conducted under conditions of extreme turbulence, he questioned the accuracy of the Reynolds Number correction. He suggested that, if available, a thrust meter in conjunction with the torque meter now available would provide an excellent means for checking propeller efficiencies under actual operating conditions. He asked also whether the Reynolds Number used is the effective one or the test value.

The Reynolds Number of test was used, Mr. Symington replied, as effective Reynolds Number is true for lift only. Speaking of the NACA laminar flow mentioned by Mr. Burstein, he pointed out that, if you take skin friction out, there sometimes is no drag left.

Ralph H. Upson emphasized that Mr. Symington's work

assumes a turbulent boundary layer and that, unfortunately, for the most part, this condition is true but that it may change in the future.

Confirming Mr. Burstein's recommendation Mr. Wright emphasized that much of the correlating trouble is due to the uncertainty of engine power and conditions and that the torque meter, which can be obtained commercially for many radial engines, and the thrust meter, developed for the Service, should eliminate this uncertainty.

Prof. M. J. Thompson, University of Michigan, asked Chairman Altman whether the screen in the wind tunnel reduces the maximum speed and was told that it does by about 20%.

"What can be done when the model presented for test has one shape and, when completed, it has another?" Mr. Altman asked. In such case, Mr. Symington replied, we would have to go back and make it the same. The hope for more data covering more planes in another year was voiced by John A. Lee, United Aircraft Corp.

PRODUCTION SESSION

E. R. Smith, *Chairman*

How to make better spotwelds and how to design, operate, and maintain the hobs for making quieter, stronger gears were the subjects of the two practical papers presented at this session.

The Spot Welding of Automobile Grade Mild Steel – **DR. WENDELL F. HESS and ROBERT A. WYANT, Rensselaer Polytechnic Institute. (Presented by Dr. Hess)**

SIX principal factors affecting the quality of spotwelds in low-carbon steel were enumerated and discussed by the authors: electrode pressure; time of current flow; amount of current; size, shape, and alignment of electrodes; surface condition of material; and consistency in maintenance of all the foregoing factors as predetermined, optimum values or conditions. Their paper, they explained, reports an investigation planned by the Resistance Welding Section of the Industrial Research Division of the Welding Research Committee for the purpose of determining the fundamental relationship between the various factors affecting the quality of spotwelds in auto-body steel. In pursuance of this objective, they continued, a portion of the time of Mr. Wyant, the Resistance Welding Research Fellow at the Rensselaer Polytechnic Institute was devoted to this work. An ample supply of auto-body steel, 0.05% carbon and 0.036 in. in thickness, was furnished for the investigation by a member of the Resistance Welding Committee connected with the automotive industry.

Comparing dome-shaped with flat tips, they reported that dome-shaped tips seem to have superior advantages. For example, reduction of electrode-alignment difficulties; longer life between dressings; and optimum welds were produced with almost 1000 amp less current. Strength and indentation, oily stock, grain size, and electrode pressure dwell time, also were discussed at length.

The future research program, they concluded, includes a more intensive study of dome-shaped electrode tips; investigation of spotwelding of additional gages of the same material using additional electrode tip sizes; further work on the time of electrode pressure dwell; and studies of various factors affecting the water cooling of the electrodes.

Discussion

The various structures illustrated in the slides were confirmed by at least two complete sets of similar runs, Dr. Hess replied to his first questioner. Consistently good spotwelds should not take less than 6 cycles to take care of slight differences in surface condition and in welding machines, he declared, answering another query from the floor. When the welds last 12 cycles or longer, he continued, distortion may result. To a third question he asserted that they insisted that the direction of pull shall be in the direction of grain for the greatest weld strength.

Agreement with the authors' comparison of flat-faced electrodes with dome-shaped tips was expressed at this point by Dr. F. R. Hensel and E. F. Holt, P. R. Mallory & Co., in prepared discussion read by Mr. Holt. Tests to determine the relative electrode life of the two types, he reported, indicated that the larger mass of electrode metal immediately adjacent to the weld when using dome tips might steepen the thermal gradient in the tip nose; this might result in less surface disturbance and minimize electrode annealing, assuring a longer electrode life. In their opinion, the following factors must be evaluated before definite recommendations could be given for optimum weld strength using dome-faced electrodes: the size at the weld area as a function of the tip face radius; the relative penetration of the work with consequent decrease in unit pressure and decreasing current density; and the relative yield points of electrode material and weld metals. These three factors, Mr. Holt explained, would have to be correlated with respect to varying welding conditions of secondary current, time, and pressure. He went on to describe a new material for welding under conditions where efficient water cooling was not available. Production tests carried on with this material, a copper-zirconium-cadmium bronze alloy, he announced, have shown its superiority with regard to retaining its original contact surface area and, therefore, maintaining the quality and consistency of the welds over a large number of spots. He suggested that some of this material be investigated in the future program of the authors.

Ground Form Finishing Hobs – **CHARLES R. STAUB, Michigan Tool Co.**

SINCE quiet gears must be accurate gears, Mr. Staub emphasized, the demands for accuracy in gearing have been increasing constantly and have given rise to the utmost accuracy in hob manufacture. Although stating that the machine-relieved hobs formerly used exclusively will still suffice for many purposes, he pointed out that such hobs would no longer do in cases where silent running, most exact uniformity of rotation, or close fitting is stipulated. For such purposes, he said, relief-ground hobs should be used, explaining that these hobs differ from the machine-relieved hobs in that the flanks and tops of the teeth, often also the root, are ground after hardening.

In his presentation Mr. Staub covered important points in the manufacture and care of hobs; the elements that should be watched for accuracy; the care that should be taken in sharpening hobs and mounting them on the hobbing machine for cutting gears; and the importance of accuracy in hobbing machines and accuracy of gear blanks for quiet and efficient gears.

"Sharpen frequently," Mr. Staub urged; "it is the most important rule for the maintenance of hobs. It is always more economical to sharpen more often," he explained, "removing only a little from the face of the tooth than the reverse as, after the cutting edges become blunt, deep pitted portions of the tooth flanks very soon become effected by the wear. The time apparently gained by running the hob longer is turned into loss by the more rapid wear and by the longer grinding time; consequently the tool life is shorter."

In summing up he declared that there are two very important reasons why hobs should be kept properly sharpened – economy and better work. Economy, because a sharp hob will cut much faster, use less power, and wear much longer; better work, because a sharp hob will produce more accurate work with a finish far superior to that obtainable from a hob not in first-class condition.

Mr. Staub also discussed design principles, hob contour, hob centering gages, hob setting for precision gears, hob run-out, composite effect of hob cutting teeth, and recording the hob positions.

Discussion

A series of slides, explained and discussed by H. A. Huebotter, General Motors Institute, was the only discussion of Mr. Staub's paper. Taking as his theme greater tooth strength, he pointed out principles of gear tooth and hob design that contribute to this objective. He showed how an increase in the base radius contributes to greater strength by comparing strength calculations of gear designs generated by a sharp-cornered hob with those generated by round-nosed hobs. He prefaced his remarks by reviewing the fundamentals of gear-tooth strength calculations and by defining his terms.

TRANSPORTATION AND MAINTENANCE SESSIONS

Chairmen

H. O. Mathews **G. W. Laurie**

Few Annual Meeting lead-off sessions of the Transportation and Maintenance Activity have attracted greater attendance than was on hand to hear J. A. Moller present the opening paper. Enthusiasm and great attendance continued at the second T & M Session where Errol J. Gay's paper stimulated considerable discussion on maintenance instruments.

Engine Deposits and the Effect of Some Fuel Additives – J. A. MOLLER and HARRY L. MOIR, Pure Oil Co. (Presented by Mr. Moller)

THE authors reported equipment used and procedure followed in determining ratings of fuels and of engines in so far as they affect or are affected by fuel deposits. In other words, they stated, the paper is a discussion of fuel-residue ratings.

Their study, they said, indicates that the combustion chamber of any internal-combustion engine, operating under any given set of conditions or under varying sets of conditions, is constantly attempting to attain and maintain an overall equilibrium which is composed of, and is being constantly balanced between, many definitely interrelated and interdependent equilibriums – mechanical, thermal, and chemical.

The disturbing of any one of these equilibriums, they added, must be balanced or offset by compensating changes of one or more of the rest of the equilibriums.

It was also indicated in the study that the maintaining of the deposition equilibrium at a point which reduces its effect on the overall engine equilibrium, both quantitatively and qualitatively, is desirable, they declared, adding that it would appear that the obtaining and maintaining of such minimum deposition is possible by use of the proper quantity of the correct type of additive.

Discussion

The operators' case was stated by Fred L. Faulkner, Armour & Co., the first man called upon to present discussion. For years, he said, operators have been trying to hold down excess engine deposits. They have experimented with dopes – but don't like them, and don't like to buy additives in cans, he continued. However, he added, they would welcome fuel properly treated initially with additives such as described in the authors' paper. Mr. Faulkner asked Mr. Moller if the critical deposit point of highly leaded fuels is different than for fuels with a lesser percentage of lead, and was told that there is practically no difference.

T. C. Smith, American Telephone & Telegraph Co., noted that we are adding "medicines" to both fuel and lubricating oil to make them better. Will this, he asked, force operators to the position where they will have to rely on a single source for these products to prevent getting "medicines" that do not mix? Mr. Moller averred that all legitimate "medicines" mix.

Dr. Ulric B. Bray, Alox Corp., referred to a part of the authors' paper where they emphasize the effect of deposits on octane requirements, pointing out that, with engines on the borderline of knocking, a reduction of even three or four octane numbers in the fuel requirements might help. He also brought out the effect that lubricating oil has on octane requirements, and declared that there remains much work to be done in developing additives for both fuels and lubricants.

In one curve the authors showed that with untreated fuel the octane requirements of an engine increased for some 25 hr before an equilibrium was reached, dropped sharply when an additive was used, and climbed back rapidly when untreated fuel was again used. In some cases the additive brought the octane requirement below that required at the beginning of the test when the engine was clean.

Commenting on this, Dr. Bray asked why the second climb was so rapid, and suggested that the reason the octane requirement dropped below the original was due to the additive removing some gum left by the oil as well as some left by the fuel. Or, he added, the engine might have lost some of its compression through lazy valves and bad rings.

Answering Dr. Bray, Mr. Moller explained that the treated fuel only takes out about 25 or 30% of the deposit, by weight, and therefore less time is taken for the deposit to build up again. He also noted that the surface of the piston is not clean as it was originally, and that the deposits have less trouble in sticking.

Reducing deposition, he continued, often reduces octane requirement to less than originally because the engine is broken in and the deposit has been removed without disturbing the thermal or mechanical equilibrium.

H. K. Cummings, National Bureau of Standards, entered the discussion to state that the Bureau is working toward determining the effect of deposits on octane requirements, and added that it has adopted similar apparatus to that used by Messrs. Moller and Moir. A. G. Marshall, Shell Oil Co., Inc., noted that his experience bears out the findings of the authors.

Instrumentation and Its Effect on Motor-Vehicle Maintenance – ERROL J. GAY, Ethyl Gasoline Corp.

INSTRUMENTATION as it pertains to motor-vehicle maintenance should cover not only tools and test devices, but also the man using these tools and devices, Mr. Gay asserted. Without intelligent understanding and handling, he explained, no instrument, regardless of its design or cost, is of much value. His paper considered instrumentation as applied to fleet maintenance.

If general maintenance is poor and if the attitude of the fleet owner toward poor maintenance is indifferent, he contended that money spent on instrumentation is wasted. Each fleet owner, he declared, must evaluate the cost of instrumentation in the light of the savings to be expected. He divided the test equipment needed in fleet maintenance into three groups:

Group A – Essential equipment for any fleet, 10 vehicles and up.

Group B – Essential equipment for larger fleets, approximately 50 vehicles or 250,000 gal of fuel per year and up, equipment of Group B to be added to the Group A list.

Group C – Probable equipment for fleets using 1,000,000 gal of fuel per year, and up. This equipment would be added to the Group A and B lists.

The major part of Mr. Gay's presentation was a discussion of the 15 items in the Group A list, 13 items in the Group B list, and 9 items in the Group C list.

In his closing summary he emphasized that much of the returns to be expected from any program of instrumentation depends upon the desire of the owner to use this equipment and to continue to use it faithfully day after day, and that the use of satisfactory records to get a true valuation in returns due to better instrumentation is a necessity.

Discussion

Operators commenting on Mr. Gay's paper unanimously agreed with the statement of Capt. O. A. Axelson, Columbia Gas & Electric Corp., that it included the first intelligible list of instrument requirements for fleets. Some remarked that it didn't go far enough, others took issue with certain points made, but all welcomed it as a timely and important contribution.

Trained personnel, said Capt. Axelson, is like the weather – something we talk about but never do anything about. Men train themselves, he believes. If they are good, fine, but, if not, operators often replace them. Too few men, he contended, can take advantage of courses offered by trade schools or those conducted by the instrument companies. He agrees with Mr. Gay that, if the fleet-shop personnel can't operate instruments, the fleet operator throws money out of the window in purchasing them.

This thought was seconded by Fred L. Faulkner, Armour & Co., who disagreed about the practice of dismissing men because they fail to comprehend the use of modern maintenance instruments. It is a better practice, he believes, to

purchase instruments and equipment according to the mentality and training of the men who will use them.

The possible savings by instrumentation as shown by Mr. Gay, said one discusser, indicate that adequate equipment of this type, plus trained personnel, should pay dividends.

State and municipal governments, Capt. Axelson pointed out, have taken over brake, headlamp, and wheel-alignment testing for many of the small operators, with their inspection stations and safety lanes, thus saving expenditures for such instruments. He is not in agreement with the author's suggestion that the smaller fleets should have gasoline-pump and fuel-level test stands, arguing that increased efficiency by use of these instruments is not great enough to make them worth while.

Commenting on recording fuel meters, he told of an instance where one shows less fuel going into the engine than into the gasoline tank. Positive that fuel is not being stolen, he said that he is checking to find where it goes. He suspects minute leaks in the gasoline tank, but has not yet made certain.

Chairman Laurie asked about checking new trucks for efficiency in acceptance tests, and the next discusser, Henry Jennings, *Commercial Car Journal,* voiced his belief that such tests might result in interesting and non-recurring phenomena.

Jack North, Commonwealth & Southern Corp., joined in emphasizing that operators should not purchase equipment that is above the heads of the shop men. Some operations that require special equipment and trained men can be done outside the shop, he reminded the session. He also voiced his opinion that exhaust-gas analyzers have a definite place in bus and other high-mileage fleets but are not so necessary in operations where mileage is low, such as public utility fleets, except in making special studies.

Surprise was expressed by H. L. Eberts, Montreal Tramways, that the speaker placed no stress on the keeping of records. His fleet, he said, consists of some 225 gasoline and diesel buses and 7 trolley buses and a record is kept on each vehicle and each component part. From these records, he added, it is decided at what mileages certain jobs should be done. Mr. Eberts was one of several discussers who did not agree with the author's remark that one man could do all of the tune-up work for 100 trucks. He believes that this work should be under two men – one an ignition expert and the other an expert on carburetors.

Mr. Faulkner reported that his company has abandoned the use of stationary exhaust-gas analyzers in favor of road-test equipment. He explained that field travelers supplied with exhaust-gas analyzers and other tune-up equipment make the rounds of the different garages. Use of this equipment, he reported, has resulted in fuel saving of as much as 10%.

In summing up Mr. Gay pointed out that, in the instances where one man does tune-up work for 100 trucks, he does no repair work. Answering a comment by Major M. V. Brunson, Quartermaster Corps, U. S. Army, that spark-plug cleaners damage the plugs, Mr. Gay said that he believes the companies making these machines have developed an abrasive that does the work without causing damage.

DIESEL-ENGINE SESSIONS

Chairmen

P. E. Biggar **F. G. Shoemaker**

Supercharging, injection systems, and exhaust smoke were spotlighted for close scrutiny in the two Diesel-Engine Sessions. Spirited debate on the merits and demerits of Roots, vane-type, eccentric, and exhaust-turbine-driven blowers was precipitated by the supercharging paper read at the first session.

The effect that the filtering system of the injection equipment has on the type of fuel that can be used in a diesel engine was brought out forcibly in a second paper. Discussion of the final paper on exhaust smoke brought out a new criterion, "exhaust lachrymation" – a measure of the degree that "smoke gets in your eyes."

Supercharging High Speed Four-Cycle Diesel Engines – **ROBERT P. RAMSEY, Superior Engine Division, National Supply Co.**

TRACING the evolution of the high-speed diesel from 1922, when 325 rpm was considered high speed, Mr. Ramsey described several of the early diesel engines which were applied to mobile equipment. Various forms of combustion chambers were commented upon by the author, as were injection systems.

In 1936, he recalled, the National Supply Co. laboratory set up a research program devoted to an exploration of the possibilities of higher engine outputs and lighter weight. This included an investigation of the merits of two-cycling, increased engine speeds, and four-cycle supercharging. The analysis indicated that the four-cycle supercharging program would be followed, and the company's basic design of 4½ by 5¾-in. engine would be used, increasing the speed and output.

Mr. Ramsey traced this development work, recounting results with various types of blowers, and reporting changes in engine design.

The latest development of this basic engine, complete as a marine design with fresh-water closed cooling system, reversing gear, raw-water pumps, and all-electric starting accessories, he said, develops 160 hp at 2400 rpm. A stripped automotive engine embodying the same construction weighs 1120 lb, which amounts to 7 lb per hp. This design has had nearly 5000 hr in the laboratory and is being made ready for production during 1940. The supercharger, a Roots type, has undergone considerable evolution, he said. The design now being put into production is streamlined and jacketed, and is quite noiseless when properly air-silenced. It is thoroughly reliable, and little or no maintenance is required, he added.

Discussion

The bottleneck in supercharging diesel engines is the blower itself, argued Russell Pyles, Clark Brothers Co., in offering discussion. He noted that the author had pointed to one limitation of the Roots type when he explained that to get output he had to cool the air. Mechanical friction heats the air in this type blower. He expects in the not distant future pressures up to 20 lb per sq in. will be required, and that we must have blowers that have more thermal efficiency than those of today.

The vane type, he said, has greater thermal efficiency, but it is less efficient mechanically, and the net result is about the same. Lee Oldfield, Schwitzer-Cummins Co., told of work done on the development of a vane-type blower at Wright Field. The particular design, he said, was not adaptable to small units and the work was discontinued.

Mr. Oldfield said that he had examined eccentric blowers imported from England and found that, although "the workmanship was poor, the performance was excellent." He remarked that most diesel men are inclined to believe that the diesel engine requires dry air, but added that the vane-type blower can't produce it. As a matter of fact, he continued, the Roots type doesn't either. His company would, he added, do some development work on the vane-type blower if they can be assured that the diesel man would put up with a little oil vapor.

Both Martin Berlyn, Dominion Engineering Works, Ltd., and the author agreed with Mr. Oldfield's comment on the vane-type blower. In his paper the author told of early work with this type and stated that it was discarded only because it was not made in this Country.

Answering a question put by Mr. Berlyn, Mr. Ramsey said that there is an advantage to opening the exhaust valve almost at bottom-center.

It was contended by C. B. Jahnke, Cooper-Bessemer Corp., that the exhaust-turbine supercharged engine is more efficient than that with the mechanically-driven type, because the latter requires considerable power to drive. An American company, he said, is starting to manufacture an exhaust-turbine supercharger and should be able to cut its cost to a point where it will be commercially available.

On the subject of valve overlap, he advocates that an overlap of 140 deg is best. This, he said, is possible only in direct-injection engines where a part of the piston is cut out for clearance. This overlap, he added, gives better scavenging across the pistons, cleaning out the last of the burned gases, which results in a greater percentage of clean air in the cylinder to be utilized for the following combustion cycle.

Other discussion by Hans Fischer, Lanova Corp., listed advantages of the exhaust-driven blower over the mechanically driven as: 10 to 15% greater output of engine; 8 to 10% better fuel economy; air delivery adjusts itself automatically for the required load and speed; maximum required overlap of the valves, therefore better scavenging. He believes that the cost of these exhaust-driven blowers can be reduced materially. Mr. Fischer continued his discussion with comments on combustion-chamber design principles.

Effect of the Viscosity of the Fuel Oil on the Injection Equipment for Oil Engines – **G. W. BAIERLEIN, American Bosch Corp.**

THE filtering system is the link in the injection-equipment set-up for oil engines which determines the limit of the viscosity of the fuel used – all other effects are negligible when compared with this, Mr. Baierlein revealed. His paper discussed the effects of the viscosity of the fuel as arising in an injection system between the supply tank and the nozzle, bringing out to what extent the viscosity of the fuel oil affects the various components of the injection system.

Early in his paper Mr. Baierlein pointed out that the viscosity of the fuel oils of different origin and analysis burned in oil engines today varies between 30 and 65 sec Saybolt Universal at 100 F.

The limit of fuel viscosity determined by the filtering system, he continued, lies at 200 sec Saybolt Universal and, with this limitation, no difficulties are expected so far as supply pump, injection pump, and nozzle are concerned, the more so since, in actual operation on the hot engine, the viscosity of the fuel is generally lower.

The effect of the viscosity of the fuel handled by the injection equipment on its lapped parts, such as plungers and barrels, delivery valves, and spray nozzles, is negligible, Mr. Baierlein reported, as exhaustive endurance laboratory and service tests have demonstrated. Conceding that there is an increase in wear with lower viscosities, he contended that the increases were so minute as to be negligible, so that the percentage drop in volumetric displacement cannot be considered sufficiently pertinent to warrant ruling against the use of these lighter fuels.

The effects of fine abrasives or solids suspended in the fuel and not held back by the filtering system, by far outweight the effect of the viscosity itself on the wear of the lapped parts, such as plunger and barrel, discharge valve, and spray nozzle, he reported.

From the diagrams flashed on the screen he showed that the effect of the viscosity of the fuel oil used on the volumetric efficiency of the fuel supply pump, even for viscosities as high as 350 sec Saybolt Universal, is small only.

On the whole, he continued, the viscosity of the fuel has very little effect on the fuel-delivery characteristics of the injection pump, especially for viscosities above 65 sec Saybolt Universal.

The duration of injection is affected very little by the viscosity of the fuel, he reported, but the effect of the viscosity on the spray velocity or penetration of the fuel spray is marked. The higher the viscosity, the poorer naturally is the atomization and the larger are the fuel droplets. Larger fuel droplets in turn mean greater depth of penetration, he explained.

Discussion

Increasing the capacity of the filter used to prevent damage to the injection system from entrance of foreign particles by increasing the supply pressure should not decrease the efficiency of the filter for removing particles of a particular size, Edred T. Marsh, National Advisory Committee for Aeronautics, contended in prepared discussion read to the meeting in his absence. However, he added, with dirty fuel, more frequent filter changing may be necessary. He emphasized the importance of the fuel supply pressure in reducing the violent pressure fluctuations existing on the intake side of the pump caused by the cut-off at the pump discharging into the same fuel space as the intake. The decline in volumetric efficiency for the low-viscosity fuels, he explained, is also due to vaporization of fuel and release of air in the vacuum formed in the pump chamber on the return stroke of the plunger. He then gave formulas for the fuel leakage and peak pressure in the discharge tubing. In closing, he pointed out that the displacement of a pump is affected by the density and compressibility of the fuels used, and that Mr. Baierlein's results could be plotted to show the effect of these variables.

In reply Mr. Baierlein repeated his conclusion that increase in fuel supply pressure has a decided effect on filtering efficiency. He agreed that it is true that vaporization of fuel and release of air in the barrel contribute to the decline in volumetric efficiency for the low-viscosity fuels, but contended that leakage in the barrel contributes the largest percentage of the decline. "We too found that leakage is greater, the lower the viscosity and higher the pressure," he noted. Referring to the effect of density and compressibility on volumetric efficiency of the pump mentioned by Mr. Marsh, Mr. Baierlein averred that his statement is true theoretically but that their influence is minute only, as brought out by the NACA itself in its Technical Report No. 477 by A. M. Rothrock and E. T. Marsh.

The Control of Smoke in the Automotive Diesel – **W. W. MANVILLE, G. H. CLOUD, A. J. BLACKWOOD and W. J. SWEENEY, Standard Oil Development Co. (Presented by Mr. Blackwood)**

IMPROVEMENT in the control of smoke in the automotive diesel engine can be brought about by the use of lighter fuels of suitable ignition quality in cases where either design, maintenance, or adjustment fail to accomplish the degree of smoke control desired, the authors concluded. However, they pointed out, this control is accomplished by some reduction in power and a loss in fuel economy. It would appear more desirable, they feel, to take the power loss required for smoke control by means of resetting the smoke stop adjustment while retaining the advantage from an economy standpoint of the higher Btu per gal of the heavier fuel. On engines having no smoke stop, they explained that the desired result can be obtained by a suitable stop or turnbuckle arrangement in the throttle connection to the cab controls.

The satisfactory performance of the heavier fuels in European bus operation clearly shows, they believe, that smoke control can be effected by other means than resorting to fuels approaching kerosene in volatility, reporting that, in the London operations, smoke and odor complaints are less since introduction of the diesel equipment than when burning gasoline.

Another finding reported was that the effect of cetane number on smoke is less important than the effect of volatility, except in cases where the ignition quality of the fuel is below the minimum demanded by considerations of roughness and cold starting.

The study reported in their paper not only covered the relationship between fuel properties and smoking, the authors announced in their introduction, but also included work on the effect of engine design, mechanical condition, and adjustment of the equipment on smoking. Not included in the program are other problems associated with smoking and objectionable exhausts from diesels, such as the related questions of odor, lubricating oil, and operating temperature, they said.

Discussion

Prof. C. W. Good, University of Michigan, led off the discussion by reading written contributions by Charles S. Moore, National Advisory Committee for Aeronautics, and R. A. Rose and A. F. Robertson, University of Wisconsin.

Comparing the carburetor gasoline engine with the fuel-injection diesel engine, Mr. Moore asserted that the carburetor gasoline engine will have a black smoke exhaust if the fuel-air ratio is excessively rich. This condition prevails, he pointed out, even with an extremely volatile fuel and a fuel-air mixture much more homogeneous than in a diesel engine. The diesel engine, he said, smokes at much leaner fuel-air ratios than does the gasoline engine.

"Does not this comparison indicate a fundamental reason

why the diesel engine exhaust is smoky, even with excess air in the combustion chamber?" he inquired. Regions of over-rich fuel-air ratio in the diesel combustion chamber in which the fuel cracks or burns incompletely may cause the exhaust smoke, he believes. Therefore, he reasoned, it is indicated that the task of eliminating exhaust smoke is one of devising means of obtaining more uniform mixing at high fuel-air ratios.

Messrs. Rose and Robertson maintained that it is necessary to distinguish between different types of exhaust smoke, whether it is white, black, or a mixture of the two. White exhaust smoke, they explained, is the result of failure of combustion in its early stages, whereas the black smoke indicates failure of complete combustion in the very last stages of the process. Sketches of the combustion chambers of the various engines tested, they suggested, undoubtedly would explain some of the results reported.

Reserving comment on the "interesting theories" advanced by Mr. Moore, Mr. Blackwood replied only to Messrs. Rose and Robertson. Conceding that they are probably right in distinguishing between kinds of smoke, he emphasized, however, that all types, white or black, are objectionable. With reference to the engines used, he pointed out that their makes had to be withheld for obvious reasons, but that he would be glad to tell any individual engine manufacturer which one his is.

If the 35% fixed by the authors as acceptable smoke is to have a definite meaning, in conjunction with the calibration curve shown, we would need to know the length of the smoke-meter tube, maintained Prof. P. H. Schweitzer, The Pennsylvania State College, reading his prepared discussion. Because of the non-linear indication of the galvonometer, he explained all the curves plotted in "% smoke" would bend up steeper if the instrument had read in foot-candles as the simple self-contained G. E. lightmeter does. Fig. 2, he pointed out, shows a paradox – the higher the load, the less the smoke at speeds above 1800 rpm. This condition, he explained, is perfectly possible with a low-cetane fuel and poorly igniting fuel, adding that the engine tested should certainly keep away from low-cetane fuels. Prof. Schweitzer wondered also why the smoke meter failed to prove satisfactory in field tests.

The term, "exhaust lachrymation," was introduced to the session in the prepared discussion of W. V. Hanley and H. R. Porter, Standard Oil Co. of Calif., read by J. R. MacGregor of the same company. By this term, they explained, they designate that property of exhaust gas which causes smarting and burning of the eyes and which, in extreme cases, results in tears. This fuel characteristic, they continued, is independent of smoke and odor and, in some cases, has assumed a greater importance. They then reported tests that indicated that "exhaust lachrymation" decreases with increase in cetane number and is independent of fuel volatility, and could be corrected only by increase in cetane number of the fuel. Other test results reported showed that exhaust smoke was decreased with: (1) increase in volatility for a constant cetane number and (2) with increase in cetane number for constant volatilities.

Answering Prof. Schweitzer first, Mr. Blackwood agreed that the relations of the calibration curve depend upon the smoke meter used and that, in his opinion, the paradox mentioned is not uncommon. He explained how the difficulties of using the smoke meter in the field during accelerating conditions had precluded its use. Referring to the discussion of Messrs. Hanley and Porter, he opined that he was not sure that smoke can be related directly to cetane number. "California climate," he concluded, "may explain the difficulties in correlating tears per mile with smoke."

TRUCK, BUS AND RAIL CAR SESSIONS

Chairmen

R. M. Critchfield **B. Frank Jones**

Diesel, fleet, and oil men joined truck and bus builders in considering the most effective ways of getting automotive diesel engines started when the mercury drops to zero, at the T B & R Monday afternoon session. Mr. Lighton read the paper, and both he and Mr. Riggs answered questions from the floor when Chairman Critchfield called for discussion. On Tuesday afternoon the T B & R men heard a thorough analysis of special design features peculiar to multistop delivery vehicles.

Observations on the Cranking of Diesel Engines – L. E. LIGHTON and H. C. RIGGS, Electric Storage Battery Co.

(Presented by Mr. Lighton)

BASING their comments on data obtained from several hundred individual cranking tests on different types of engines, the authors outlined some of the important factors to be considered in the electrical starting of diesel engines, particularly at low temperatures. Cathode-ray oscillograph equipment was designed and used for obtaining accurate data on power and speed requirements for effective starting.

They stressed the necessity of knowing the viscosity characteristics of the lubricating oil used, regardless of its SAE number. When there is no provision for maintaining heat in an engine, they stated, the low-temperature viscosity should preferably be no higher than 50,000 Saybolt sec.

Methods of applying auxiliary heat were discussed by the authors, and they emphasized the importance of fuel-injection timing.

They pointed out that a more rapid temperature rise may be obtained from high cranking speed by a reduction in blowby in so far as this is possible through the selection of piston material and piston fit.

The importance of a starting motor of the proper size and design to provide adequate torque at satisfactory cranking speeds for minimum starting temperatures was noted, as was the importance of the proper battery. The properly designed battery, they said, will deliver a very high current to meet the high torque requirements and still maintain a high sustained voltage to provide high cranking speed so essential for quick starts. The authors also commented on the merits and limitations of different system voltages, including 12, 24, 32, 64, and 110 volts. Before concluding, they pointed out that in most instances a diesel-engine battery will require more attention during its life than one used for a gasoline engine.

Discussion

L. A. Calkins, Valvoline Oil Co., was first on his feet when the discussion period opened, asking the effect of viscosity of oil in cylinder walls in starting diesel engines. In answering, Mr. Lighton said that about 60 to 65% of cranking resistance of an engine is tied up in the cylinder walls.

When asked why they made no reference to fuel oil, with the comment that some oils won't flow at the temperatures used in the tests, Mr. Lighton reported that fuel oils were an early worry, but that they had found a commonly available oil that did work and used that through the tests. Mr. Riggs added that they had found very little difference in starting time with 50 and 60-cetane fuels, and that a longer period was required with 45-cetane fuel. Sometimes, he noted, the engine would not start with 35-cetane fuel.

H. L. Eberts, Montreal Tramways, told of operating diesel buses in an area where the temperature drops to 45 deg below zero. They are forced to keep buses in a garage with the temperature between 50 and 60 F. Some of the older diesels, he said, won't start at 45 F because the starting motor does not crank the engine fast enough.

Commenting on this, H. P. Vaughan, General Motors Diesel, said that a high-speed diesel must be turning at a rate approximating its idling speed before it would fire – and that it is necessary for the starting motor to help the engine overcome wall drag up to idling speed. Mr. Vaughan stated that

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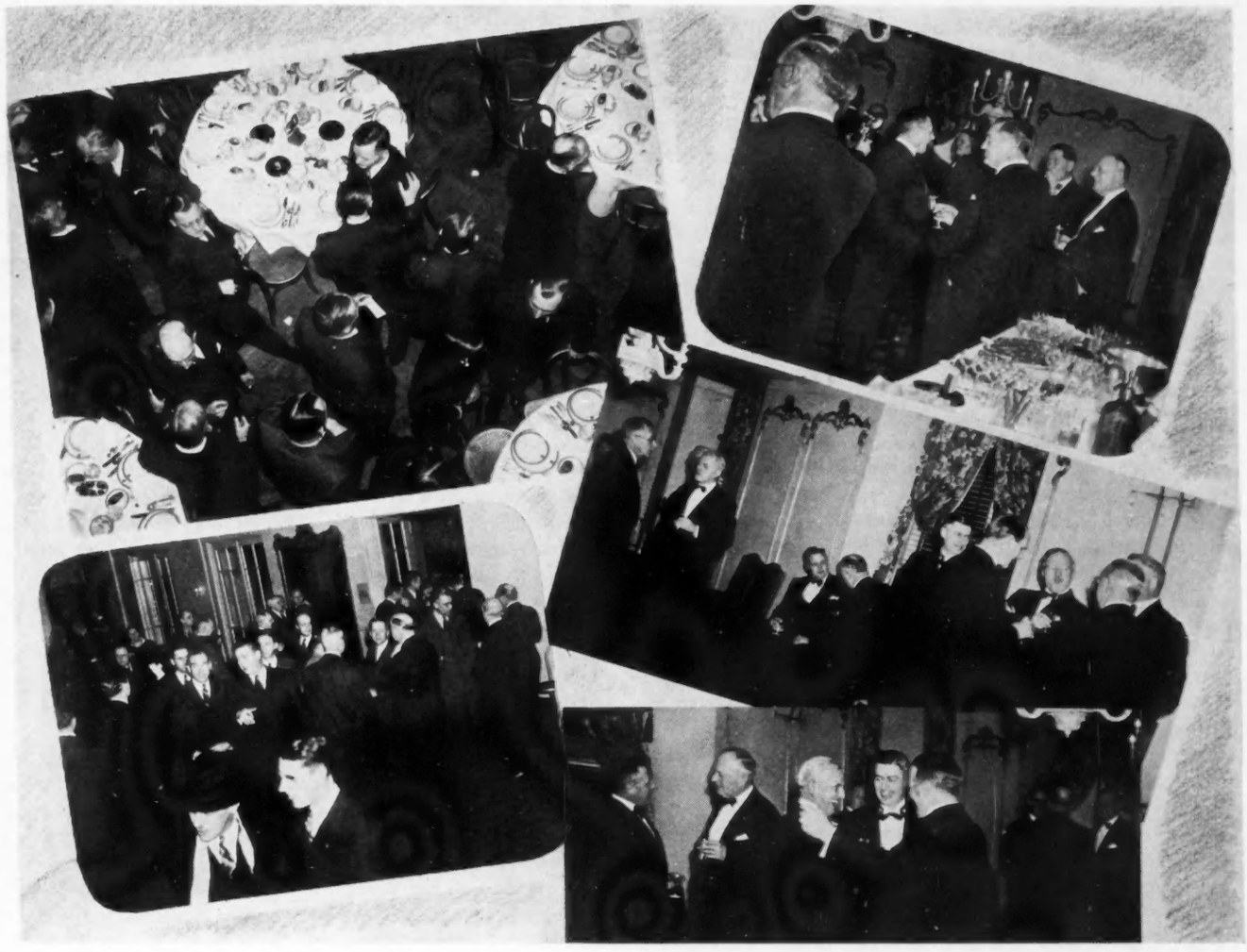


the gear-reduction starting motors are not fast enough to do this.

Mr. Critchfield also took exception to the authors' suggestion that the back-geared cranking motor is most satisfactory for high-speed diesels. The need for cranking diesels at relatively high speeds, together with the fact that higher torque is necessary, Mr. Critchfield said, indicates that considerable power is required in cranking. Series-type cranking motors, he averred, are ideally suited for this type of service.

Responding to a question by A. Verne Jackson, Chevrolet, Mr. Riggs noted that engines with high compression ratios start more quickly, but that compression ratio made negligible difference in battery requirements. Comparing the power required to start diesel and gasoline engines of the same displacement, when asked by Peter M. Heldt, *Automotive Industries,* Mr. Riggs gave the ratio required as something like 13:1.

M. J. Brennan, Willard Storage Battery Co., was commended by the authors when he urged careful attention to cable requirements. Mr. Riggs noted that a 0.4-v loss means a sacrifice of about 5 rpm in starting a motor.

Mr. Lighton, in summing up, declared that the most important point brought out in the paper and discussion is that it pays to make a thorough analysis of starting requirements before installing cranking equipment. Above all, he said, don't guess!

Multi-Stop Delivery Vehicles **– RALPH WERNER, United Parcel Service.**

DECLARING that the retail delivery department of an organization influences ultimate profit to a much greater degree than generally supposed, Mr. Werner took as an example the dairy business where the transportation cost can represent an expense many times the profit, and a reduction of 10% in this one item can often double profits.

He defined the different types of multi-stop vehicles and offered suggestions on factors to be considered in selecting a delivery car. The type of service, he showed, is of major importance and must be considered when deciding on a vehicle's weight, power, load distribution, body size and shape, driver's seat, doors, and method of control. Incorporated in his talk were suggestions for vehicle designers as well as for fleet operators.

He illustrated his talk with slides picturing the various types of multi-stop delivery vehicles offered in this country today.

Discussion

At the conclusion of his paper, Mr. Werner read a series of short comments prepared by the different truck companies emphasizing the features of their multistop units. Those covered included the International "Metro," the White "White Horse," the Mack "Retailer," the Walker "Dynamotive," the Diamond-T "Black Horse," "Pack-age-car," "Divco-Twin," and the Delivery Vehicle Co. "D.V.C."

Robert Cass of the White Motor Co. added a few suggestions to those made by Mr. Werner when he was called upon by Chairman Jones. Decreasing overall length, he pointed out, means reduction of garage space needed which, in turn, means a reduction of overall delivery cost. He also pointed

to the adoption of completely welded bodies which, he said, adds to the initial cost but brings a further reduction in operating cost.

The driver, in many instances also is a salesman, and it is necessary to protect him from fatigue by providing flexible operation, ease of getting in and out of the vehicle, a comfortable ride, and insulation, against all kinds of weather, he declared.

There was some argument about doors. Mr. Cass favored folding side doors, commenting that they provide the easiest operating and lowest operating cost. Sliding doors, he said, inevitably are leaky, accumulate dust in the slides, and are definitely an object of maintenance. Mr. Werner favored the sliding door, and both speaker and discusser were opposed to the passenger-car-type door.

On the subject of rear doors Mr. Cass noted that there is a preference for many features that can best be incorporated locally. Merrill C. Horine, Mack Mfg. Corp., expressed his preference for the sliding overhead type, explaining that they are wide, easy to operate, and do not overhang. Mr. Werner's objection to this type was based upon his experience that they often stick. He prefers the side-sliding variety at the rear, but conceded that often they are not wide enough. This can be remedied, he said, by having a hinged panel to one side, which drops, giving additional width, when large items are to be loaded or unloaded.

Mr. Horine declared that there is too much emphasis on fuel economy for short-haul vehicles. He maintains that it is better to provide increased reliability, ease of operation, and better performance. He did note, however, that idling consumption is an important consideration.

Mr. Werner would go no further than to state that he is a great believer in steam cooling, when asked about temperature control in this type of operation. He expressed his opinion that temperature control, engine ventilation, dilution, and kindred subjects could well occupy a session by themselves, and should be taken up at another time.

FUELS AND LUBRICANTS SESSIONS

Chairmen

A. G. Marshall **W. M. Holaday**

Progress in finding out why different cars rate the same fuel differently on the road was evident in the imposing amount of test data presented in the nine papers of the "Symposium on Detonation Performance on the Road," comprising one F & L session. In three papers read at a second session a slightly higher octane requirement was reported for 1939 cars than for 1938 cars; the usefulness of the CFR Motor Survey and the CFR Gasoline Survey was emphasized; and practical research on journal bearings was revealed.

Detonation Symposium

"Although we have had a good example in this symposium of how the knock-rating problem gets more and more complex as we get further and further into it, all is not confusion as some here have intimated, but definite progress is being made, contended Chairman Holaday summing up and relating the nine papers making up the "Symposium on Detonation Performance on the Road." The papers read were: "Knocking Characteristics of Individual Hydrocarbons as an Aid in the Interpretation of the Behavior of Gasolines in Engines," by J. M. Campbell, General Motors Research Laboratories; "Fuel Distribution in Multicylinder Engines and Its Effect on Knocking and Performance," by Harold J. Gibson and Cleveland Walcutt, Ethyl Gasoline Corp.; "The Effect of Volatility on Correlation of Road and Laboratory Ratings," by A. E. Becker and G. H. B. Davis, Standard Oil Development Co.; "Engine and Fuel Variables," by W. E. Drinkard, Chrysler Corp.; "The Effect of Variations of Air-Fuel Ratio on Octane Number Ratings Obtained on 1939 CFR Road-Test Fuels," by Harold M. Trimble, K. C. Bottenberg, and L. A. McReynolds; "CFR Road Tests 1939 – The Effect of Mileage or Car Use on the Road Antiknock Value of Different Fuels," by T. H. Risk, Pure Oil Co.; "Progressive Changes of Octane-Number Requirement with Mileage," by C. S. Bruce, National Bureau of Standards; "Effect of Carbon on Octane Number," by John Duckworth, Standard Oil Co. (Ind.); and "Description of a Road-Test Knockmeter," by A. E. Traver and C. E. Habermann, Socony-Vacuum Oil Co., Inc.

To introduce and explain the purpose of the symposium Chairman Holaday read excerpts highlighting the CFR 1939 Road-Test Program. It was formulated, he explained, to plan a study of why different cars rate the same fuel differently and of road knock-testing procedure with a view to improving its precision and making it more adequate for its intended purpose. He pointed out that a study of the problem involves an analysis of the effects produced by two different groups of variables: engine variables and fuel variables. He named seven engine variables suggested as being worthy of further study: ignition timing, mixture ratio and fuel distribution, carbon accumulations, atmospheric conditions, mixture temperature, jacket temperature, and engine speed. Fuel sensitivity and fuel volatility, including distribution of antiknock value along the distillation curve, were the two fuel variables suggested for further study, he said. Chairman Holaday also read test-fuel specifications.

Data that show "why it is difficult, if not impossible, by present methods of attack, to assign a definite antiknock rating to a given fuel which will be valid in different engines under different conditions of operation," were presented by the first contributor, Mr. Campbell. Moreover, he predicted, these data indicate that, as the present trend toward manufactured fuel of high octane number advances, these problems will become of even greater importance than they are now.

Early investigations, he recalled, led to two important conclusions: that knock was largely dependent on the molecular structure of the fuel and that relative knocking tendencies of different hydrocarbons vary over a wide range. He pointed out that this latter observation has opened up a field of almost unlimited possibilities for synthetic fuels, provided that they have the desired molecular structure. Mr. Campbell's data showed that the pure hydrocarbons are represented by a wide range of critical compression ratios; that the relative knocking tendencies of pure hydrocarbons are enormously affected by changes in engine conditions; and indicated the changing relationship between two gasolines under different extremes in engine conditions.

"Fuel Distribution in Multicylinder Engines and Its Effect on Knocking and Performance," was the subject of the contribution by Harold J. Gibson and Cleveland Walcutt, presented by Mr. Gibson. Confirming earlier findings of Bartholomew, Chalk, and Brewster they found that during full-throttle acceleration from low speed, the differences between air-fuel ratios of individual cylinders may be quite large. These data indicate, Mr. Gibson explained, that, during the beginning of acceleration, the average of the fuel-air mixtures in the cylinders is leaner than that at the carburetor, that it becomes richer than the carburetor mixture as the speed increases, and finally becomes equal to it. Mixture heating, they discovered, reduces the differences in individual air-fuel ratios and reduces the extremes of richness and leanness of the average fuel-air mixture.

The contribution of Dr. Becker and Mr. Davis was read by Dr. Becker. He pointed out that the work of Bartholomew, Chalk, and Brewster has raised the question whether the distribution of octane number in the various fractions of a fuel, together with its volatility, may not be an important factor not only in determining its antiknock performance, but also in solving the more general problem of correlation of road and laboratory ratings.

As a result of tests under summer conditions they concluded that "the road rating of a fuel is equal to the Research rating of either the first 90% evaporated of the fuel or the distillate to 300 F, whichever is the larger portion of the fuel."

The principal item investigated by Mr. Drinkard, the next contributor to report, was the influence of mixture distribution on individual cylinder detonation characteristics. His paper gives the results of a study made relative to the behavior of the four CFR road-test engines when operating a current-model 6-cyl engine, he announced.

The difference between the detonation tendency of the various cylinders, when each is operated at maximum-knock mixture ratio, he pointed out, is due to engine mechanical differences, operating differences (temperatures, pressures, and so on), and to differences in fuel-quality distribution. He emphasized that there is a distinct difference in the quality of mixture received by the individual cylinders.

In conclusion he brought out that engine and fuel variables both introduce factors ultimately affecting the road octane number of a fuel; the variables discussed are only a few of those existing; and the elimination of either fuel or engine variables alone will probably not be sufficient for material improvement in the existing conditions. Either set of variables allowed to exist is of sufficient importance to hinder us in reaching our desired goal, he believes.

Variations in knock rating of as much as 7 octane numbers are possible as a result of variations in air-fuel ratio, Mr. Trimble revealed, reporting the results of road tests in the paper by himself and colleagues. The data also indicate, he added, that the point of maximum knock is in the lean air-fuel range.

Road and laboratory octane numbers were determined, he explained, on the 1939 CFR road-test fuels Nos. 5, 6, 7, and 8 at various air-fuel ratios, Fuel No. 5 being a high-octane material in light fractions; Fuel No. 6, a high-octane material in heavy fractions; Fuel No. 7, a sensitive fuel of 70-72 octane number, non-leaded; and Fuel No. 8, an insensitive fuel, leaded to 70-72 octane number.

The effect of mileage or car use is generally most noticeable during the first 10,000 miles of operation or for a corresponding period after a "valve-and-carbon job," Mr. Risk brought out. During this general increase in fuel antiknock requirement, he went on, it is also probable that cars will also change their relative ratings of fuels with respect to composition or fuel type.

Mr. Risk then gave the results of tests run to indicate the progressive effect of car mileage or use on the road antiknock ratings of the 1939 CFR fuels 5, 6, 7, and 8. Three popular-priced 1939 cars were used and tests were made at the start, after 5000 miles, and after 10,000 miles of operation, he reported. The car fuel relationship was determined by the "borderline road-test method" using the CFR fuels and several blends of secondary reference fuels A, C, and F.

Although the tests give certain indications, Mr. Risk concluded, "we do not feel that we have covered a sufficiently wide selection of cars to warrant definite conclusions."

An increase in octane-number requirement of 25 units was caused by operating a car for 12,500 miles, less than one-third of which was due to carbon accumulation and the remainder due to engine condition, Mr. Bruce revealed in his contribution.

During this operating period, he continued, the change in spark setting necessary to maintain a constant octane-number requirement of 65 was 9 crankshaft deg. He reported determinations on a 1938 automobile at intervals up to 12,500 miles, and on a 1939 car of the same make after it had been driven 10,500 miles. At 13,000 miles, he said, carbon was scraped and six more determinations of octane-number requirement were made during the next 2700 miles.

The procedure involved for each determination, he explained, involved finding the spark setting for incipient knock with each of a dozen fuels which ranged from 40 to 80 octane number. He displayed a curve giving both the resulting octane-number requirement at the manufacturer's recommended spark setting and the spark setting required for any specified octane-number requirement. All the experimental results were corrected to standard atmospheric conditions, he said.

More data "to add to the general confusion," were read to the meeting at this point by J. O. Eisinger, Standard Oil Co. (Ind.) who summarized the contribution of John Duckworth of the same company. These data indicated that there was no relationship between the weight of carbon removed and the amount that the octane requirement is raised (or lowered). He reported on three cars which were tested thoroughly. One car, after 37,000 miles of carbon accumulation, after cleaning showed very little drop in octane requirement whereas another car with less mileage showed a drop of more than 30 octane numbers; another that had gone 19,000 miles showed a reduction of 5 octane numbers.

Development of an instrument which helps to replace the ear in the measurement of knock intensity in road test cars, was announced in the paper by Messrs. Traver and Habermann, presented by W. S. Mount of the same company. Use of the device in rating fuels by the maximum knock procedure, they pointed out, has increased the speed and accuracy with which results can be obtained. He explained that the knockmeter is simple in construction and is a portable unit which can be changed from one car to another without loss of time.

The use of a sensitive voltmeter for indicating knock intensity in place of ear phones or other listening devices, has avoided the necessity for complete elimination of engine noises, he brought out. A reduction in the mechanical noise is effected by use of a high pass filter, he said, so that sufficient sensitivity to knock is obtained for speeds up to the 40 to 50 mph range. Variations in knock intensity resulting from unequal manifold distribution and other mechanical variables, he explained, are averaged in a detector tube circuit. This circuit is designed with a long time constant so that its averaging effect is produced without serious loss of sensitivity.

He pointed out that the increased intensity of mechanical noises at high speed has made it difficult to obtain instrument ratings with fuels producing high speed knock. Improvements are now being made which it is hoped will permit ratings on all fuel types, he concluded.

Curves that are the result of a large number of tests on 500 fuels were displayed by C. E. Cummings, The Texas Co., in prepared discussion. He explained that they had deliberately plotted a large number of points in an effort to determine the reasons for the lack of correlation – to find out how much of it was caused by experimental error.

A lighter note in the discussion was sounded by Charles B. Kass, Standard Oil Development Co. "Realizing the utter confusion resulting from the lack of correlation between road and laboratory knock-rating results displayed here this after-

(*Concluded on page* 64)

About SAE Members:

A. A. MAYNARD, formerly assistant chief engineer of Adam Opel, A.G., Russelsheim, Germany, is now affiliated with General Motors of Canada, Ltd., Oshawa, Ont., as director of engineering.

W. B. MOORE, associated some 20 years with the Timken Roller Bearing Co. in various sales capacities, has been appointed director of sales of the Steel & Tube Division. Since 1933 Mr. Moore has been manager of industrial sales.

The appointment of **HARRY E. SCHANK** to the position of chief engineer of the McCord Radiator & Mfg. Co. recently was announced. Mr. Schank joined the McCord organization in 1922 as research engineer, and since early in 1938 has been in charge of radiator design and development. As chief engineer he will direct the engineering of all products in the McCord line. Prior to joining the McCord organization

Harry E. Schank
Chief Engineer

Mr. Schank was connected with Cushman Motor Works, Lincoln, Neb.

FRANK LESLIE GARTON, formerly director of the engineering research laboratory of Shell Oil Co., Inc., Wood River, Ill., is in England as chemist with the Asiatic Petroleum Co., Ltd., London.

EDWARD R. STETTINIUS, JR., chairman of the board, U. S. Steel Corp., has been elected a member of the Corporation of the Massachusetts Institute of Technology.

C. H. DOLAN, II, vice-president and American manager of the Intercontinent Corp., has been made 1940 chairman of the Aeronautic Division of the American Society of Mechanical Engineers. He has been affiliated with the aeronautical industry for more than 25 years, and in his present capacity assisted in building an aircraft factory and maintenance plant in China.

DR. PER K. FROLICH, chief chemist, Standard Oil Development Co., has been named a councilor of the American Chemical Society.

Woolson Heads Chrysler Institute

HARRY T. WOOLSON, executive engineer of the Chrysler Corp. and a past-president of the SAE, has been named president of the Chrysler Institute of Technology. Mr. Woolson succeeds Dr. James Shelby Thomas and will continue his duties as executive engineer in addition to those of his new post. Mr. Woolson is also a member of the Board of Education and the Board of Trustees of the Institute.

JAMES C. ZEDER has been made chairman of the Board of Education of the Chrysler Institute. Other SAE members on the Board are **CARL BREER** and **A. G. HERRESHOFF. FRED M. ZEDER** continues as chairman of the Board of Trustees of the Institute. **O. R. SKELTON** and Mr. Breer are also trustees.

January brought two honors to **WILLIAM L. BATT,** president of SKF Industries, Inc., who was principal speaker at the SAE Annual Meeting Dinner in Detroit last month. He was elected chairman of the Business Advisory Council, Department of Commerce, succeeding W. Averill Harriman, on Jan. 12. In this capacity he heads a group of nearly sixty of the country's top industrialists and financiers. Earlier in the month he became chairman of the board of the American Management Association, filling a vacancy left by the death of James O. McKinsey, late chairman of Marshall Field & Co.

HUGO LUNDBERG, president of the Lundberg Screw Products Co., Lansing, Mich., is a director of the recently reorganized Reo Motors, Inc.

The Sylvanus Albert Reed Award for 1939 was presented to **GEORGE J. MEAD,** vice-chairman of the National Advisory Committee for Aeronautics, Jan. 26, at the Honors Night and Annual Dinner of the Institute of the Aeronautical Sciences. The IAS confers the award each year in recognition of a notable contribution to aeronautical engineering. Mr. Mead was honored "for the design and development of high-output aircraft engines for military and commercial services."

O. L. BRYAN, formerly with the Stanolind Oil & Gas Co., Tulsa, Okla., is designer with the Hydraulic Production Corp., Dallas, Tex.

After returning to the United States from Brussels, Belgium, his headquarters as European service manager and transportation engineer for the International Harvester Co., **HARVIE H. STRAWN** was named service manager for the company at Long Island City, N. Y.

ALBERT H. WOOD has established a practice as consulting automotive safety engineer with offices in Toronto, Ont., catering to insurance companies and the legal profession. His

Albert H. Wood
Consultant on
Automotive Safety

work includes inspection of large bus and transport companies, together with accident investigation, testing and grading of drivers, and expert testimony in legal actions. Mr. Wood was one of the organizers of the SAE Canadian Section.

F. FRANCIS DONOGHUE is connected with the Reed-Prentice Corp., Worcester, Mass. He was formerly with the Carbondale division of Worthington Pump & Machinery Corp., Harrison, N. J.

DR. JEROME C. HUNSAKER recently was appointed to the National Advisory Committee for Aeronautics for a term expiring Dec. 1, 1944. Dr. Hunsaker is director of the aeronautical engineering department of the Massachusetts Institute of Technology.

GEORGES HENRY ROESCH, formerly chief engineer, Sunbeam-Talbot, Ltd., London, England, now is associated with Jaeger Instruments British, Ltd., of the same city.

R. C. NORBERG, who has been vice-president and general manager of the Electric Storage Battery Co., Philadelphia, recently was elected president. He will continue his duties as general manager along with those of his new post.

HOWARD A. FLOGAUS, for the past year assistant to the vice-president of the J. G. Brill Co., Philadelphia, has been made chief engineer. Prior to joining Brill, Mr. Flogaus was chief engineer of Reo.

PHILIP B. TAYLOR, chief engineer of the Wright Aeronautical Corp., Paterson, N. J., is starting a five-year term on the board of trustees of the Montclair (N. J.) Free Public Library. He has been a resident of Montclair since 1905, is chairman of the Adult Education Center of that city and vicinity, and is interested in other civic activities.

HENRY GLENN TOWNSEND is production engineer with the Harvey Machine Co., Los Angeles, Calif., manufacturers of tools and gages for the aircraft industry.

CLARENCE W. NELSON, who has been with the United States Department of Interior Bureau of Biological Survey since 1935, is stationed at the Rice Lake Migratory Waterfowl Refuge, East Lake, Minn., as camp supervising mechanic.

Since the first of the year **DAVID LEE GUNDRY** has been draftsman with the Davenport Machine Tool Co., Rochester, N. Y. He was with the Rochester Products Division of General Motors Corp.

GEORGE STOWE has joined the White Motor Co. as salesman. He is located in Long Island City, N. Y.

ELEANOR ALLEN, formerly detailer with the airplane wheel and brake division of the Bendix Products Division of Bendix Aviation Corp., South Bend, Ind., has been transferred to Bendix, N. J., as detailer with the Pioneer Instrument Division of Bendix Aviation.

WILLIAM STANTON MARSDEN is motor transport service manager with the United States War Department, Quartermaster Corps, Headquarters 2nd Corps Area, Governors Island, N. Y.

OLIVER HENRI COTÉ, JR., is located at the United States Naval Aircraft Factory, Philadelphia, as junior aeronautical engineer.

WALTER R. RAMSAUR is manager, heat transfer products division, Airesearch Mfg. Co., Glendale, Calif. He formerly was with the Young Radiator Co., Racine, Wis., as sales engineer.

AMA Committee Changes

PAUL G. HOFFMAN, president, Studebaker Corp., has been named chairman of the highways committee of the Automobile Manufacturers Association, succeeding **JAMES D. MOONEY,** vice-president, General Motors Corp., who continues on the committee. **C. E. WILSON,** vice-president and director of General Motors Corp., and **HERMAN WECKLER,** vice-president of Chrysler Corp., succeed **WILLIAM S. KNUDSEN,** president of General Motors, and **K. T. KELLER,** president of Chrysler, on the AMA manufacturers committee.

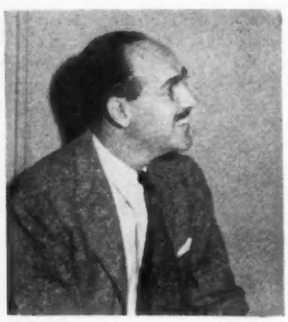
Two SAE members have been added to the board of the Continental Illinois National Bank & Trust Co. of Chicago. They are **FRED J. FISHER,** Detroit, founder of the Fisher Body Corp., and **CHARLES D. WIMAN,** president of Deere & Co., Moline, Ill.

CECIL VIVIAN WHITTA, formerly service manager, Paine Bros. (Motors) Ltd., Auckland, New Zealand, is managing director of Better Brakes (N. Z.) Ltd., of the same city.

JOHN A. WATTS, who was engineer with the Hartford Accident & Indemnity Co., has joined the Cummins Engine Co., Columbus, Ind., as engineer.

WATT E. BABLER is sales manager of the General Power Devices Co., East Detroit, Mich., manufacturers of vacuum power brakes. He formerly was district manager for the Saginaw Stamping and Tool Co., Saginaw, Mich., and the Electric Wheel Co., Quincy, Ill.

E. D. HERRICK has been named president of the Linn Mfg. Co., Morris, N. Y. Mr. Herrick was president of Lycoming Manufacturing



E. D. Herrick
Makes
Change

Corp., Williamsport, Pa., before becoming chief executive of the Linn organization. He had been with the Lycoming organization for a number of years, and before that was associated with the Johnson Bronze Co.

SID G. HARRIS is eastern factory representative for Pines Winterfront Co. of Chicago. Previously he was district manager for Macmillan Petroleum Corp., and before that eastern sales engineer for Continental Motors Corp. Mr. Harris is a past-chairman of the Metropolitan Section.

LEWIS K. MARSHALL, general service manager, Pontiac Motors Division of General Motors Corp., was chosen to represent car manufacturers as guest chairman at the annual banquet of the National Standard Parts Association held in Chicago, Dec. 14, during the Automotive Service Industries Show.

H. W. GRAHAM, director of metallurgy and research, Jones & Laughlin Steel Corp., Pittsburgh, was among the speakers at the winter meeting of the Industrial Research Institute in Chicago, Dec. 8 and 9.

Sutphen Motorboat Show Veteran

The 1940 National Motorboat Show held in New York early last month is the 35th that has been held. It also marks the 35th year that **HENRY R. SUTPHEN** has had a part in the show. Mr. Sutphen, who is vice-president of the Electric Boat Co. and president of the National Association of Engine & Boat Manufacturers, is a member of the Association's show committee. Other SAE members active on the show committee are **CHARLES A. CRIQUI,** Sterling Engine Co., who is 1st vice-president of the Association, and **EVERETT E. PALMER,** treasurer of the Association. **IRA HAND,** secretary of the NAE&BM, was show manager. He has held that post for the past 13 National Motorboat Shows.

Beecroft to Represent SAE at Safety Conference

At a recent meeting the SAE Council accepted an invitation from the Greater New York Safety Council for the Society to cooperate in its 11th Annual Convention, to be held in New York, April 16-18. **DAVID BEECROFT,** Bendix Products Division of Bendix Aviation Corp., was appointed to again serve as the Society's representative.

MAJOR MARK V. BRUNSON, Quartermaster Corps (Motors), now in charge of the War Plans Section of the Office of the Quartermaster General, Washington, D. C., has been selected by the Secretary of War for attendance at the 9-month course given at the Army Industrial College, effective Sept. 2, 1940. In July, Major Brunson will pursue a refresher course for field officers at the Chemical Warfare School, Edgewood Arsenal, Md.

HARRISON L. HART, who for 27 years was connected with the Wico Electric Co., Springfield, Mass., of which he was general sales manager, has been appointed by the Pines Winterfront Co., Chicago, as factory representative in the farm tractor division. Mr. Hart recently established himself in Chicago as sales representative for several manufacturers.

HARRY STROHM is associated with the sales department of the King-Seeley Corp., Ann Arbor, Mich. Before making this connection he at different times held executive sales posts with Warner Schebler Carburetor, division of Borg-Warner Corp., Bendix Products Corp., Marvel Schebler Carburetor, division of Borg-Warner Corp., Pines Winterfront Co., and Modern Tool & Die Co.

RICHARD W. BLAIR, formerly a member of the SAE Student Branch at Ohio State University, is with the Wright Aeronautical Corp., Paterson, N. J., as experimental engine tester.

F. E. HOLSTEN, formerly with the Barnsdall Refining Corp., Tulsa, Okla., is executive vice-president of the Chalmette Petroleum Corp., New Orleans.

COL. OLIVER B. ZIMMERMAN, consulting agricultural engineer and educator, has been selected to receive the Cyrus Hall McCormick Gold Medal of the American Society of Agricultural Engineers for 1940. The medal will be formally awarded at the annual meeting of the Society next June at Pennsylvania State College. The award is based on the aggregate of the

Col. Oliver B. Zimmerman
Medalist

medalist's accomplishments through a continuing career, rather than on any single success.

Col. Zimmerman has been a member of the SAE since 1920, and in 1934 was presented with a life membership in the Society for his SAE activities and his contributions to the industry. He was vice-president of the Society representing Tractor Engineering in 1925 and has been very active in work of SAE Standards Committees. After his retirement from the International Harvester Co., with which he had been affiliated since 1911, with the exception of the World War period when he served with the United States Army as captain of engineers, and later as major, Col. Zimmerman has practiced as consulting engineer, currently in connection with C. H. Wilson & Co., Chicago. He was commissioned lieutenant-colonel in the O.R.C. in 1924.

DR. H. K. CUMMINGS, chief, automotive power plants section, National Bureau of Standards, has been reappointed by the SAE Council to represent the Society in the American Documentation Institute.

(*Continued on next page*)

Three Generations—All SAE Members

When Henry Ford II recently became a member it was the first time that three generations of one family have been on the rolls of the Society at one time.

Henry Ford, who is one of the founders of the Society, signed application No. 2 when he joined the SAE in 1905. Edsel Ford became a member in 1925, and Edsel's son, Henry II, became an associate member last month.

Henry Ford II is a director of the Ford Motor Co. and attends Yale University, where he is manager of the varsity crew.

CHARLES MERZ, who drove in the first 500-mile race at the Indianapolis Speedway, has been appointed assistant to **T. E. MYERS,** vice-president and general manager of the Indianapolis Motor Speedway Corp. Mr. Merz was chairman of the SAE Indiana Section in 1937.

Charles Merz
Takes Speedway Post

JOHN J. BLOOMFIELD, JOHN W. THORP, and **CHARLES E. MACDONALD** have joined the Vega Airplane Co., Burbank, Calif. Mr. Bloomfield will serve as consultant on transmission devices, continuing at full time a position formerly held on a part-time basis. Mr. Thorp, who was on the faculty of the Boeing School of Aeronautics, Oakland, Calif., is group engineer, and Mr. Macdonald, formerly with Chrysler Corp., Detroit, is doing drafting work in the engineering department.

MAJOR LESTER D. GARDNER was elected executive vice-president, and **SHERMAN M. FAIRCHILD,** chairman of the board, Fairchild Aviation Corp., New York, and **R. H. FLEET,** president, Consolidated Aircraft Corp., San Diego, were among those elected vice-presidents of the Institute of the Aeronautical Sciences at a meeting of the IAS Council, Jan. 18. **LEROY R. GRUMMAN,** president, Grumman Aircraft Engineering Corp., Bethpage, N. Y., was elected treasurer. **EDWARD P. WARNER,** Civil Aeronautics Authority, addressed the Institute on "Looking Into the Future with Respect to Air Transport Design," at its 8th Annual Meeting, in New York, Jan. 24-26.

H. PERRY SMITH resigned as vice-president and secretary of the W. G. B. Oil Clarifier Co., Kingston, N. Y., to form and become president of Upackit Filter Products Co., Philadelphia.

GEORGE H. KELLER has been test engineer with the Wright Aeronautical Corp., Paterson, N. J., since the first of the year. He previously was research assistant at the Pennsylvania State College.

FRANK N. SINGER has been appointed by the American Trucking Associations as assistant to **CHARLES G. MORGAN, JR.,** manager of the division of operations. Mr. Singer's experience covers installation of maintenance systems for truck fleets, and the supervision of a fleet of 200 trucks.

E. H. FENN, formerly project engineer with Pratt & Whitney Aircraft, has joined the staff of Commonwealth Aircraft Corp., Pty., Ltd., Melbourne, Australia.

W. H. BLACKMER has been appointed sales engineer for the New England and New York areas of the John S. Barnes Corp.

FRANK E. JOLLEY has established a practice as consulting engineer of motor transportation at 99 N. Stanwood Rd., Columbus, Ohio. He previously was director of Motor Transport, Ohio State Highway Department.

ROGER F. WINCHESTER is doing equipment set-up work with the Allison Division, General Motors Corp. at Speedway, Ind. He was with the Fisher Body division of General Motors Corp. at Janesville, Wis.

GEORGE R. WALT is manager of the Lansing Storage Co., Lansing, Mich. He previously was inspector in the engine inspection department, Standard Oil Co. (Ind.), Whiting, Ind.

About Authors

(*Concluded from page 13*)

machinist apprentice in railroad work his varied career has taken him to Texas as service representative for Buick and to Mexico during the Madero-Villa Revolution, in charge of mechanical operations for Corrigan-McKinney Corp.'s mining developments. He was later chief tool designer and master mechanic for Hart-Parr, which, during 1916 and 1917, was making shells and gun mounts for the British. When the United States entered the War he joined the Motor Transport Corps, and became a captain before he left the service in 1919. From 1919, until he joined Chrysler Corp. as staff master mechanic in 1929, he was master mechanic and general superintendent of the John Deere Tractor Co. Besides being president of the Chrysler Sales Division, Mr. Wallace is also president of Chrysler's Marine Engine Division and of the Chrysler subsidiary Pekin Wood Products Co., Helena, Ark.

Obituaries

Victor W. Kliesrath

Victor W. Kliesrath, vice-president of Bendix Aviation Corp. and a member of the SAE since 1910, died suddenly Dec. 21, at his home in Manhasset, Long Island, after a heart attack.

Known throughout the automotive industry as inventor of the vacuum booster brake and other automotive devices, Mr. Kliesrath also was widely known for his contributions to the marine field. He worked for the Edison Electric Co. and the Bosch Magneto Co. before the formation of the Bragg-Kliesrath Corp., of which he became president. When this firm affiliated with the Bendix organization a few years ago, he was named director and later vice-president of Bendix Aviation and director of its marine development division. He also was a member of the executive committee of the Johnson Motor Co., makers of outboard motors.

Interested in both automobile and motorboat racing, Mr. Kliesrath took part as a driver in both sports. He was twice winner of the Gold Cup speedboat race and collected many trophies in lesser events.

Mr. Kliesrath was 58 years old. He was born in New York and received technical training at Cooper Institute.

Lewis T. Rhoades

Lewis T. Rhoades, president of the New York Coil Co., Mont Clare, Pa., and a member of the SAE since 1915, died recently.

At the time Mr. Rhoades joined the SAE he was electrical engineer and vice-president of the New York Coil Co. He continued with that organization until his death, except for a period when he was engaged in work outside of the automotive industry. In 1929 he became president of the company.

Mr. Rhoades entered the automotive industry in 1903 as designer with the Relay Motor Car Co., Reading, Pa. He specialized in automotive ignition and was inventor of the Rhoades Unit Spark System. He held numerous patents on other automotive ignition devices.

Mr. Rhoades was born in Phoenixville, Pa., 62 years ago.

Marie Luhring

Miss Marie Luhring, mechanical engineer, for 21 years employed by the International-Plainfield Motor Car Co., a branch of Mack Trucks, Inc., and one of the first women to become a member of the Society of Automotive Engineers, died in Plainfield on Dec. 29, after an illness of six months. She was 47 years old.

In 1918, owing to the shortage of men, International employed 25 women. Among them was Miss Luhring, who had graduated from the Normal College of Training and had taken a two-year course in architecture at the School of Applied Design. She also had been draftsman with the Sage Foundation Homes Co., and later, on a leave of absence, had continued her study of architecture in Europe.

Two years after joining the International organization Miss Luhring became an Associate Member of the SAE. She was at that time, in addition to her work, taking night courses at Cooper Union, and in 1922 was the only woman in a class of 22 to receive the degree of Mechanical Engineer. She held various engineering positions with International in New York, Long Island City, and Plainfield. At the time of her death she was automotive designer.

Anthony H. G. Fokker

Anthony H. G. Fokker, pioneer airplane designer and manufacturer, died in New York on Dec. 23, after an illness of three weeks. He was 49 years old and had been a member of the Society since 1924.

Born in Java, the son of a coffee grower, it is said that he did not wear shoes until, at the age of six, he moved with his family to Holland. Although he was not a success at school, he was mechanically adept. In 1910 he built his first monoplane and taught himself to fly; the first step toward becoming a dominant factor in the development of modern aircraft.

Mr. Fokker first attracted attention during the World War when he designed planes for the German High Command. He had been impressed as a German citizen and was not permitted to cease the manufacture of airplanes which he had begun before hostilities broke out. However, he continued to regard himself as a Hollander and a neutral. During the war he designed more than 40 types of planes and developed a system of synchronizing machine-gun fire with propeller speed. He also designed motorless aircraft and suggested the glider train.

In 1922 Mr. Fokker came to the United States and organized an aircraft company which later joined forces with General Motors and, as the General Aviation Corp., was established at Wheeling, W. Va. At his factory in Amsterdam, the Nederlansche Vliegtuigenfabrik, N. V., he recently had been building planes for the Finns and other Scandinavian countries.

The Fokker T-2, one of the many planes which he sold to the United States Government, was the first to fly non-stop across the American continent. Fokker 3-engined planes carried Admiral Byrd and Floyd Bennett to the North Pole, and Byrd, Balchen, Acosta, and Noville across the Atlantic. Another was used by Kingsford-Smith on his historic Pacific crossing, and later when he circled the world. Mr. Fokker's 3-engined planes became the prototype for early American transports. He later developed the first large 4-engined plane built in this country, and in Holland pioneered the 9000-mile airway from Amsterdam to the Netherland Indies.

News of the Society

Field Editors

Baltimore – R. C. Hall
Buffalo – C. W. Georgi
Canadian – Warren B. Hastings
Chicago – Austin W. Stromberg
Cleveland – J. W. Morrison
Dayton – R. H. Henry
Detroit – William F. Sherman
Indiana – Harlow Hyde
Kansas City – L. P. Mecklenburg
Metropolitan – Leslie Peat
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New England – J. T. Sullivan
No. California – C. W. Spring
Northwest – R. J. Hutchinson
Oregon – J. O. Brice
Philadelphia – H. E. Blank, Jr.
Pittsburgh – Murray Fahnestock
St. Louis – A. R. Burgess
So. California – C. T. Austin
So. New England – L. F. Campbell
Syracuse – No appointment
Washington – George A. Barker

Creative Design Tied To Production Methods

● So. New England

Some engineers actually feel that a knowledge of manufacturing processes hampers their creative thinking, Bayard D. Kunkle, vice-president and director of manufacturing, General Motors Corp., told a well-attended Southern New England Section Meeting on Jan. 3. Just how serious this limitation may become, he indicated, is pretty much a measure of a man's mental capacity. Any design must be manufactured if it is to be put into use, he pointed out, even though creative imagination is involved in its conception. Though a design may be hampered because existing methods are not adequate to its manufacture, any up-to-date plant recognizes the primary importance of satisfactory design and puts a corresponding amount of effort into development of processes for satisfactory commercial creation of the product.

Correlation of engineering and manufacturing operations is governed in different organizations by the type of product and by the mutual interests of the heads of the engineering and manufacturing divisions, Mr. Kunkle said. Every reasonable effort is made to have the product reflect, not only advanced design, but adaptation to the best manufacturing practices.

There are three stages in any design, Mr. Kunkle continued: (1) the characteristics, both physical and functional, are prescribed; (2) the design changes made to meet those characteristics are put into physical form. (This physical form must be proven by test to fulfill the conditions laid down.); (3) Processes are developed to permit satisfactory production of the design.

The first of these stages is purely engineering. The second involves engineering with intelligent manufacturing consultation; the third manufacturing process development with intelligent engineering consultation. It is in the second and third stages, said Mr. Kunkle, that a more profitable co-relation of activities can be established.

When the product must be sold competitively, he continued, the engineering job is not completed merely by making the design satisfactory from a functional standpoint. It must also withstand price competition. The design must be satisfactory for its purpose, in other words, it must fulfill that purpose more economically than other designs offered competitively.

Mr. Kunkle called attention to the purchasing department as a source of information on new materials and processes. As an example, he showed samples of oil pump gears made from powedered metal much as a headache tablet is made.

Slides were shown of parts which had been changed slightly so as to achieve cost savings running to thousands of dollars without reducing the effectiveness of the part.

Over a year ago, Mr. Kunkle said, it was decided, as a part of his company's Manufacturing Staff program, to attempt to develop greater consciousness of the waste of materials and a more concentrated study of economical manufacture of parts in production. For this purpose, contacts were started with the various Divisions and they were requested to submit parts or processes which they felt had been outstanding advances in their engineering and manufacturing procedure. An exhibit was made up of the information and parts submitted, and representatives of the various Divisions made a study of these exhibits with a view to using the same or similar processes in their own plants.

100,000-Mile Truck Life Goal of Newspaper Fleet

● Chicago

How operations on a fleet of 260 newspaper trucks in fast multi-stop service are calculated on a mileage goal of 100,000 miles per vehicle, was explained by Paul Harvey, manager of the Garage Service Co., Chicago, Ill., before the transportation and maintenance meeting of the Chicago Section held Dec. 5, with Stephen Tompkins, Autocar, as technical chairman. The majority of trucks are depreciated on a four-year basis and routine service is based on a mileage schedule, speaker Harvey pointed out. This schedule consists of vehicle condition checks every 2000 miles and grease and battery-water checks at 1000-mile intervals.

Replacements, he said, are worked out on a mileage basis, as for example, 28,000 miles on brakes and 40,000 miles on clutch facings. Carburetors are renewed every 25,000 miles and spark plugs are replaced at the same interval. Reconditioning of parts is handled by mechanics who are specialists in their tasks, Mr. Harvey pointed out, and special tools, jigs, and fixtures have been developed to condition units and parts economically. Transmissions, clutches, front and rear axles, except for an occasional bearing failure, run through the 100,000-mile period with very little trouble, declared Mr. Harvey.

Collision expense is an important item in newspaper delivery service, the speaker explained, and to protect the radiator grilles and front fenders all trucks are specially equipped with husky bumper and radiator guards made of heavy angles and pressed steel channels fastened far back and securely to the chassis frame.

Loss of anti-freeze solutions in cold weather is minimized by a system employing a 1-gal tank above the windshield glass on the inside of the cab, with tubing to the radiator. This system takes care of overflow by expansion, with gravity flow of liquid back into the radiator under all conditions, he explained.

Piston ring life in the fast multi-stop service using high compression motors, declared the speaker, has been shortened about 50% due to increased piston heat. Because of this the 100,000-mile goal without replacement is not achieved on this item, and when oil consumption has reached one quart per 200 miles, which usually occurs at the 50,000-mile mark, all rings are replaced, he said.

Holding a brief for the slower, slightly larger engine over the present high-rpm motors, the speaker declared that the same performance and gasoline economy as is obtained in smaller higher-speed engines can be had from the slower slightly larger engine running at a moderate rpm. An ideal type of engine for this service and any other operation where the maximum speed is governed to a moderate rpm, he said, would be one proportioned in valve area, manifolding and carburetion for a top speed of about 2800 rpm, equipped with pistons suitable for proper heat dissipation, and rings of wider widths. Compression ratio should be suited to octane ratings available in the average gasoline, he noted.

In the discussion which followed Mr. Harvey's paper, Harry Mathews, Public Utilities Engineering & Service Corp., asked how the 100,000-mile vehicle life expectancy goal was arrived at. Mr. Harvey replied that due to body and chassis wear and tear from accidents and newspaper rush service, together with the need for replacement of mechanical parts, the 100,000-mile figure seemed most expedient as a mileage goal. Parts inventory for replacement purposes, he pointed out, total approximately $12,000.

Gilbert Larson, Ward Baking Co., said that vehicle life for Wards is set at a period of five years and that service and lubrication checks also are on a time basis. The practice of his company, Mr. Larson declared, is to convert 1½-ton units into ¾-ton special models in order to eliminate excessive clutch, transmission and rear axle breakage.

Interrogated as to battery life, tire retreading and extent of service personnel required in his fleet, speaker Harvey said 18 months is the average life for batteries; that retreading is

found more desirable than recapping; and that in the three garages operated by the company a total crew of 37 men, including foremen, keep the 260 vehicles in good operating condition. Tires are branded by number and their transfer to vehicles are recorded on a simple form. Retreads usually total 30,000 miles per retread, and at 15,000 miles tires are transferred from the front to the rear wheels. Stops, including "slow-down stops," approximate from 500 to 600 or more per vehicle per day, pointed out Mr. Harvey, yet gasoline consumption of ½-ton trucks generally averages about 9 mpg.

Trends in Transmission Development Reviewed

● Philadelphia

A parting of the ways for passenger cars and commercial vehicles in future automotive applications of unconventional transmission principles is seen by Howard A. Flogaus of the J. G. Brill Co. Mr. Flogaus believes it likely that the range of torque conversion satisfactory for passenger cars will lead this field into design principles not entirely satisfactory for buses and trucks. Low gear ratios of 1.8 and 2 to 1, satisfactory for passenger-car operation, he states, may be produced by mechanisms not at all satisfactory for the 3½ to 5 to 1 ratios required for buses and trucks.

These views were presented by Mr. Flogaus in his paper, "Unconventional Transmissions," delivered before the Philadelphia Section's Dec. 13 meeting.

Following his brief review of transmission developments from the earliest types to those now in use, Mr. Flogaus discussed the new and unconventional transmissions under the following headings: Electrical, Hydraulic, Friction, Mechanical inertia, and Mechanically geared types.

It is regarded as doubtful, said the speaker, that the electrical means of propulsion ever will be adapted to passenger-car use, due to its high cost and weight. However, he added, it has been found thoroughly satisfactory for motor-coaches and is said to be preferred by a great number of operators.

The author pointed out that much could be done to still further popularize this type of drive by the removal of unnecessary weight. A great deal can be accomplished in the reduction of weight of such parts as the motor, generator, shafts, end frames, brush holder equipment, he explained, and noted that it is entirely likely that some of the new forms of insulation permitting higher operating temperatures will also contribute to further weight reduction. The present electrical system, as used in transit bus operation, usually involves about 1200 to 1400 lb more weight and $800 to $900 additional expense over a conventional mechanically-geared drive system, he said. However, Mr. Flogaus noted, it is an infinitely variable transmission and besides providing a smooth start and ease of control, it requires little or no maintenance.

Hydraulic Drives Explained

Hydraulic-drive systems, he explained, divide into fluid clutches and hydraulic converters. The fluid clutch was described as a simple device in the form of a two-element turbine; the driving element incorporating the turbine housing and the driven element attached to the mainshaft of the transmission. It is a closed system employing SAE 10 engine oil, as a fluid medium, and it is supplied with a small-capacity external-expansion tank, which insures a full turbine housing at all times. Mr. Flogaus states that it provides an exceedingly elastic, soft clutch, and is ideal to take care of the cyclic irregularities originating in both gasoline and diesel engines.

The hydraulic converter is a turbine with a greater number of stages, he said. The additional stages take the form of reaction blading which provide the necessary reaction to the transmission case for torque increase. While fluid-clutch efficiency increases with engine speed, the turbine reaches its maximum efficiency at speeds around 1200 to 1400 rpm, depending upon design of the blading, and drops rapidly at higher engine speeds. Mr. Flogaus says that this is not serious because the system is designed to give the coach the necessary forward thrust at the point of maximum converter efficiency and is then shifted into direct gear at some speed between 17 and 20 mph. While the coach is operating in high gear the turbine is cut loose from the engine by the disengagement of the friction clutch built into the flywheel in the conventional manner. These hydraulic converters can produce any variation of torque from 1 to 1 to about 5 to 1. As the torque build-up ratio exceeds 5 to 1, the clutch losses become too high for economical operation, Mr. Flogaus stated.

Friction Drives Analyzed

He spoke of some recent attempts to revive forms of friction drives, such as the Hayes roller transmission. This system, he explained, employs hardened and ground rollers running on hardened and ground raceways, a variation of torque being secured by tilting of the roller in such a manner as to change its contact with the race from a small diameter near the mainshaft to the larger diameter at the raceway periphery. He noted that an important problem in this design appears to be to provide sufficient pressure of the rollers against the raceways to prevent slipping and consequent scoring under the required torque conditions. The metallurgical problems, too, are rather critical and difficult to control, he added. The system does have some very desirable characteristics, he said, in that it provides a truly infinite variation of torque and also has possibilities for a very quiet convenient over-drive.

The mechanical inertia principle, as described by the speaker, employs a system of weights, cams, and levers in various arrangements to secure torque increase. While some of the transmissions employing this principle have very desirable effects at relatively low engine speeds, he said, they have not proven very successful at the higher engine speeds due to the excessively high inertia values built up in the torque changing mechanism. There are few transmissions of this type that have met with any experimental success to date, he noted.

The mechanically-geared systems, said Mr. Flogaus, fall into two classes: (1) the conventional arrangement of two parallel shafts with the required number of gears for speeds desired, and (2) the planetary-cluster type through which any desired number of speeds can be secured by using the planet clusters in series, These systems can be used in connection with either hydraulic clutches or the conventional disc type. The multiple-planetary type, Mr. Flogaus noted, has been used with a great deal of success both in this country and Europe; the foremost European design being the Wilson gear box, which is used in passenger cars and buses alike. This same type of transmission in slightly different control form also appears in the 1940 Oldsmobile, being used in connection with a fluid clutch. Another form of geared planetary transmission described by the speaker is the Banker or Monodrive mechanism which has met with considerable success both experimentally and in limited commercial application. This unit employs a centrifugal mechanical clutch and a planetary cluster providing three forward speeds.

Discussers of Mr. Flogaus's paper were Henry Wysor, metallurgical engineer, Bethlehem Steel Co.; P. M. Heldt, engineering editor, *Automotive Industries;* C. M. Billings, Gulf Oil Corp.; B. B. Bachman, vice-president and chief engineer, Autocar Co.; and Richard H. DeMott, general sales manager, SKF Industries, Inc. Mr. DeMott was chairman of the meeting.

Southern California Speaker

H. T. Youngren made the trip from Detroit to Los Angeles to tell Southern California Section members and guests all about the Oldsmobile Hydra-Matic transmission. Almost 600 were on hand to hear him. Other speakers at the Section's Jan. 12 meeting were John Wiggers and Stanley Whitworth.

600 Jam Hall to Hear Data on Transmissions

● So. California

Nearly 600 engineers and executives crowded into the Southern California Section's Jan. 12 meeting to hear Harold Youngren in person tell the story of Oldsmobile's Hydra-Matic transmission and to listen to details about the Chrysler fluid flywheel and the Yellow Coach hydraulic transmission – written by Carl Breer, Chrysler's executive engineer, and by Col. George A. Green, Yellow Truck & Coach vice-president of engineering, respectively – presented by John Wiggers, chief engineer, Moreland Truck Co. of Los Angeles.

The first public presentation of the results of the 1940 Gilmore Yosemite Economy Run by E. J. Sanders, Gilmore Oil Co., was an added feature of this dramatic gathering as was a talk on the advantages of SAE membership by Stanley Whitworth, vice-president, Studebaker Pacific Corp., who himself has been a member since 1912.

Models of the units described were exhibited at the meeting.

Reviews Automotive Maintenance Practices

● **Tulsa Group**

When some 60 members and guests of the Tulsa Group met at the Mayo Hotel, Dec. 15, the technical fare included an illustrated description of the Hydra-Matic transmission, presented by D. E. Hamilton, automotive consultant, and a paper reviewing automotive maintenance practices, by Walter E. Getschman, lubrication engineer, Mid-Continent Petroleum Corp.

The increased demands being made on commercial-vehicle engines, Mr. Getschman said, are subjecting exhaust valves, spark plugs, piston rings, and bearings to more severe punishment than ever before. However, he added, automotive engineers, by means of research, have been able to meet the problems so successfully that service of these parts is now far in excess to that experienced in earlier lower duty engines. As a result of these improvements, he continued, we have witnessed a consistent upward trend in engine power since 1937.

Compression ratios, he said, have increased about 7%. Horsepower per cubic inch is up about 5%. Brake horsepower is up 3%. Interesting in itself, Mr. Getschman commented, is the drop in displacement of about 2%, which would indicate that beyond compression ratio, greater advantage is taken of higher volumetric and thermal efficiencies.

After this introduction, the speaker stressed the importance of maintenance in these days of mounting competition, declaring that additional miles of service from engines, tires, bodies, and other parts may turn out to be the profit of a fleet.

The body of Mr. Getschman's paper was a complete review of maintenance practices based upon considerable experience in this work.

Before concluding his paper, the speaker commented on advances in tractor design. He noted that 85% of the tractors being manufactured today are equipped with rubber tires, and that 75% of them require gasoline for fuel.

Maintenance Schedule of Average Diesel Outlined

● **No. California**

"If truck diesel engines receive regular care and maintenance—such as adjusting valves and injectors, regular flushing, and periodic inspection of the various units—it is possible to make the overhaul period of a truck diesel engine from half-again to twice as long as when gasoline engines are used in the same service," so declared R. P. Meehan, San Francisco general manager for Cummins Diesel Sales Corp., at the Northern California Section's Dec. 12 meeting. He added, "this bears out, of course, the fundamental fact that diesel engines are better work engines than gasoline engines."

Today, he said, many diesel engines will run from 60,000 to 100,000 miles, and as high as 120,000 miles before removing either the oil pan or the cylinder heads. Cases of 160,000 and 200,000 miles before opening up are on record. "On the average," he said, "at 75,000 miles it becomes advisable to install rings, reface and reseat valves, and check over the connecting-rod bearings and the fuel system. At approximately 125,000 to 150,000 miles it becomes necessary to re-hone liners, install new pistons and rings, new connecting-rod bearings, and sometimes main bearings, sometimes not. At approximately 200,000 or 250,000 miles there is a rather general overhaul which will include removal of the crankshaft, possibly a re-grinding of the crankshaft, installation of new bearings, possibly new sleeves, pistons, pins, and rings, and new valves, valve guides, and a working over of the rocker-arm housings, rollers, and bushings. Upwards of 350,000 miles it becomes necessary sometimes to completely rebuild the engine."

Mr. Meehan emphasized that flushing engines out at fairly short intervals is highly beneficial to a truck diesel engine. Those operators who flush their engines about once in 5,000 miles find that wear on the engine is reduced materially, he said.

In Mr. Meehan's opinion nobody is an expert on diesel truck engines—everyone is still in kindergarten. He pointed out that it was only seven years ago that the first diesel engine was placed in truck service, and that it has been only during the past three or four years that they have been widely adopted, limiting most experience to that period.

At first, he said, electric equipment, compressors, air cleaners and oil filters were not adequate, and cost of maintaining and repairing these accessories often exceeded the cost of maintaining and repairing the engine itself. There has been a vast improvement in these accessories, and the early faults of engine design have been overcome, he stated.

Mr. Meehan predicted that in two or three years truck diesel engines of smaller bore, or displacement, will be operated successfully and the use of diesel-powered trucks will increase to cover 20 or 25% of the trucks in use in the United States.

From the viewpoint of economics, he said, the diesel truck for long-haul, cross-country, heavy-duty hauling justifies itself on a fuel economy basis. But, he added, in other types of operation, such as heavy-duty logging or dump-truck work, the diesel-powered truck justifies itself on the basis of better performance or more payload per day.

Taking exception to a remark by Mr. Meehan that "a diesel engine won't make a poor oil better or a good oil worse," F. E. La Fehr, Standard Oil Co. of California, stated in written discussion that any internal-combustion engine will make any oil worse. With gasoline engines, he said, we experience fuel dilution, the percentage dependent upon operating conditions, and with diesel engines, particularly the solid-injection type, we are confronted with by-products of combustion, namely—fuel soot. He warned against long drain periods and against over-fueling as is done by some operators to get maximum work from the engines.

The long cylinder liner, piston, and piston-ring life quoted by Mr. Meehan, Mr. La Fehr said, is a compliment to both the engine maker and the operator. But, he added, we know of many horrible examples where due to ignorance, carelessness, or desire upon the part of the operator to obtain a greater return from a given payload, there has been rapid cylinder-liner, piston, ring, and bearing wear or failure. Such abnormal wear, he contended, can always be traced to inefficient or dirty air cleaners, crankcase breathers, oil filters, and/or long drain periods. These unpleasant experiences, he declared, will continue and the lubricating oil and/or the fuel will bear the brunt of such complaints until the proper technique on the part of the operator has been learned. Even though the automotive diesel is a sturdy, reliable work-horse, it requires intelligent supervision and care, if the investment therein is to be fully realized, he concluded.

J. A. Edgar, Shell Oil Co., Inc., remarked on the trend away from burning in a diesel engine any fuel that happens to be handy, and a movement in the direction of more volatile and specially blended diesel fuels, which economics will ultimately dictate to be more costly than present diesel fuels. He added that this should not be alarming since fuel saving alone is but a small percentage of the total economies in diesel-engine use.

Combustion characteristics, Mr. Edgar anticipates, will continue to be a problem by reason of the speed increases that can be looked for in automotive diesels, diminishing the time for proper burning of the fuel. Speed increase has another aspect which will tend to keep diesel engines from becoming trouble-proof, said Mr. Edgar, as he pointed out that with each 100 revolutions increase in engine speed, lubricating oil temperature increases by some 3 F. This means, he continued, that with engine speeds increasing sufficiently to cause this temperature rise to be of the magnitude of 20 F, there results a strength decrease of 6 or 7% in the bearing metal, which will result in shorter bearing life if not compensated by oil coolers or better bearing metals.

In line with this, Peter Glade, Purity Stores, Inc., reported on the use of oil coolers on highway diesels. By using them, he said, a lubricating-oil temperature decrease of 40 F was noted, increasing tensile strength of bearing metal some 15%. He also reported less cylinder-liner and crankcase wear.

Discussion by Mr. MacKenzie, formerly with the bus division of the New South Wales Railway, Sydney, Australia, included comments on diesel-powered vehicles operated in that country. He said that it is the usual practice to use oil coolers and filters, and told of the prevalent use of hardened cylinder liners, some of which give wear rates as low as 0.001 in. per 10,000 miles in city bus operation. It is the general practice, he said, to overhaul city buses at 80,000-mile intervals, and noted that vehicles with hydraulic transmissions are found to have considerably less wear than those with mechanical drives.

Also contributing to the general discussion was F. G. Wildhagen, International Harvester Co., who remarked that he has observed definite short-comings in the gear ratios which are available with standard gear boxes and rear-axle ratios, because the resulting combinations will not permit a diesel engine to be operated within its most efficient speed range. He feels

SAE Men Leave Wives; Learn Art of Speaking

● **Detroit**

Some members of the SAE have left their homes of late
And got together Tuesday nights to argue and debate.
They left their wives, tears in their eyes, said they were very tired,
But with the front door barely closed, with vim their minds were fired.

They could take on any dozen men,
Prove that black was white, then black again.

They'd show the fellows in the class how far they'd get with facts;
They'd fill them full, of Ferdinand, before they could relax.
TUNE—"Solomon Levi"

That was one of several songs composed by W. S. Bennett, vice-president and sales manager of Bower Roller Bearing Co., on the occasion of the "graduation exercises" of the Detroit Section's course in public speaking, at a dinner Dec. 19. Mr. Bennett was class valedictorian and served as toastmaster to fulfill his final "assignment" of the semester.

"I speak freely" was the motto of the class, and Toastmaster Bennett called upon each member present to give a three-minute informal dissertation after the dinner which was attended by "pupils" and their wives. He also introduced Prof. Rupert Cortright, Wayne University, who conducted the 12-lesson course.

Several reels of motion pictures in color were shown after the program by E. J. Welker, one of the class members.

that when proper gear ratios are available it will be possible to avoid the over speeding and lugging to which a diesel engine is now subjected when the drivers go through the gears of the present heavy truck. Mr. Wildhagen believes that the present gear-ratio steps are too large and that when these are diminished there will be a decrease in smoke, obnoxious odor, and engine wear.

Following the discussion, colored motion pictures were shown of diesel-powered trucks in logging operations.

Methods of Testing Plastics Described

● Baltimore

Plastics may be classified as materials which can be formed by heat and pressure; organic plastics differing greatly in their mechanical properties from metallic materials, Willard F. Bartoe, Röhm & Haas Co., Inc., told the Baltimore Section at its Dec. 7 meeting. He stressed the importance of tests to determine the full significance of these properties.

Speaking specifically on "Testing of Transparent Plastics," Mr. Bartoe described a device known as the "hazemeter" which measures distortion. Although no method of determining permanence, other than weathering, has proven satisfactory, he said, the one upon which most reliance is placed determines relative resistance to discoloration and fading. Steps are being taken, he added, to write water absorption specifications which will take into account deterioration and distortion.

Mechanical properties of plastics, measured on standard testing machines, must be obtained on a strictly comparable basis because temperature changes and speed of load application cause wide differences, he explained.

Heat distortion and resistance to heat, both of particular importance to automotive applications, were illustrated by test specimens and by curves showing deflection under load plotted against temperature rise.

The proper use of property tables as a guide by engineers was stressed by the speaker, who also emphasized the value of practical tests and the importance of close cooperation with the manufacturer.

At the conclusion of the paper and subsequent lively discussion the Section provided appropriate Christmas refreshments which were thoroughly enjoyed by the 60 members and guests who were present.

Finds City's Atmosphere Influences Engine Wear

● Pittsburgh

Trucks operating in a clean city suffer only about half as much engine wear as those operating in cities where there is more abrasive material in the air, C. J. Livingstone, industrial fellow at the Mellon Institute of Industrial Research, told 140 members and guests attending the Dec. 12 meeting of the Pittsburgh Section. This statement was based upon studies of engine wear of fleets operating similar vehicles in various cities. The vehicles compared averaged about 100 miles per day and were idling 25% of the time. In some cities, he said, quoting American Public Health Association figures, the dust fall may be as high as 4 tons per square miles per day.

Commenting on ring sticking, he noted that naphthenic and paraffinic oil have different ring-sticking temperature ranges. He suggested that chances of ring sticking are reduced if an engine, after it has been driven hard, is permitted to idle for a short time before being shut off. He also advocated that when new piston rings are fitted, it usually is advisable to regroove the pistons because the fit of the rings against the sides of the grooves is as important as the fit of the ring against the cylinder wall.

Winter sludge trouble, said Mr. Livingstone, may be reduced by changing oil more frequently as well as by use of thermostats and radiator shutters. These oil changes, he explained, are an effective means of cleaning out the engine. The speaker also suggested a faster idling adjustment which often permits a leaner setting of the main jet, because the engine may be speeded up on the idling jet. Air-cooled cylinder heads, to prevent over-cooling, he said, also are helpful in reducing winter sludge trouble. It was pointed out that crankcase-ventilating systems which depend upon the forward motion of the engine are inefficient in service which has a high proportion of idling to miles traveled. He suggested auxiliary crankcase-ventilating systems in such cases.

Varnish, Mr. Livingstone said, may result from the diluent or the oil. In either case, he contended, frequent oil changes will remove the varnish-forming materials – which cannot be removed by oil filters because they are dissolved in the oil.

To a question on engine temperatures, asked at the opening of the discussion period, Mr. Livingstone stated that it is desirable to keep engines at as nearly the same cylinder temperature as possible during summer and winter. He explained that the engines become accustomed to working within a certain cylinder temperature range and the rings fit the cylinder walls more accurately.

In reply to a question regarding the prevention of varnish formation in new engines which operate at high crankcase temperatures, Mr. Livingstone recommended the removal of the factory-installed lubricant upon delivery and oil changes at 250, 500, 1000, and 2000 miles. He explained how the effects of new surfaces and metal particles present magnify the deterioration of the lubricant during this critical period.

He noted that engines which work hard without abnormally high crankcase temperatures last longer, adding that an engine working at too low a power factor does not do enough work to eliminate its own deposits. With carbon and varnish removers, he said, there is danger of transferring these deposits from places where they may be doing no harm to places where they may cause real trouble.

Santa Monica Scene of Big Aircraft Meeting

● So. California

One of the largest aircraft meetings ever held by an SAE Section took place Dec. 15, when the Southern California Section made Santa Monica its meeting place. More than 325 were on hand to hear T. L. Yates, chief engineer, Lord Mfg. Co., discuss "Dynafocal Suspension for Radial Aircraft Engines," Ashley Cooper Hewitt, consultant, describe the development of a small high-speed single-sleeve-valve engine, and Douglas Secor, of Fairchild Aerial Surveys, Inc., tell about a new "automatic and foolproof" aerial camera. The program was planned by Carleton E. Stryker, Bendix Aviation, Ltd., who for several years served as general chairman for SAE National Aircraft Production Meetings. Prior to the technical session there were short talks by Section Chairman Ellis W. Templin; Brint Edwards, Section vice-chairman for aeronautics; Foster Gruber, Douglas Aircraft Co.; and Mac Short, president of Vega Airplane Co.

In the first technical paper Mr. Yates described Dynafocal Suspension for radial aircraft engines as "a frictional spring mounting system which accomplishes a true center of gravity support for an overhanging mass, and provides sufficient flexibility for the absorption of both angular and translational vibratory disturbing forces, without undue loss of stability for the supported assembly."

A small-scale demonstration model, operated by A. M. Scheerer, Wright Aeronautical, Ltd., was used to show points of vibration response with several mount designs, and to give a visual idea of how various flexible mounting systems act in isolating the powerplant vibrations from the airplane proper.

Tomorrow's airplanes, Mr. Yates commented, may entail a complete revision of the present type of Dynafocal Suspension. However, he concluded, "Dynafocal Suspension does, in our minds, present a most vital step in the right direction for today's airplanes toward the reduction of structural stresses, protection of the accessories commonly mounted on the engine proper, and the realization of greater passenger comfort."

Sleeve-Valve Applications

Taking issue with general statements recently made in technical journals that the single-sleeve valve has a place in large engines, but is not suitable for small engines, mainly due to its cost, Mr. Hewitt declared, "I have felt for some time that very high outputs could be obtained from small cylinders at high crankshaft speeds, provided a small valve mechanism that would withstand the high speed could be evolved." Furthermore, he continued, "the single-sleeve valve seemed to offer the best solution to the high-speed problem, and the cost might not be prohibitive if full advantage were taken of improved manufacturing techniques, such as die casting of aluminum, and permanent-mold casting, and of the improved materials available today.

Starting two years ago, Mr. Hewitt developed such an engine built up as an outboard motorboat unit. The completed engine's size may be pictured from the fact that the flywheel is 6½ in. in diameter.

He gave the following specifications: bore, 1¾ in.; stroke, 1¾ in.; displacement 4.21 cu in.; compression ratio, 7:1; gear reduction, 3.57:1; fuel, Ethyl gasoline; and oil, SAE 50.

The power curve, Mr. Hewitt reported, shows a maximum power of 2.89 bhp at 6100 rpm. This, he said, gives a specific output of 0.686 bhp per cu in. He explained that the power is read at the outboard propeller shaft with an hydraulic dynamometer, after the power has traveled through 9 bearings and an oil seal, as well as driving a 6-ft tachometer cable and blowing the cooling air.

Mr. Hewitt stressed the flexibility in manufacturing methods noting that the engine can be made by sand casting, permanent-mold casting, die casting, forging, pressing, and stamping. The latter three, he added, would require slight changes in design.

After noting that the engine has had 150 hr of test running, more than half of them under full-load conditions at speeds between 4000 and 7000 rpm, and that the engine parts are standing up well, Mr. Hewitt concluded, "I have demonstrated, to my own satisfaction at least, that it is possible to obtain high outputs out of small cylinders running at high crankshaft speeds."

G. E. Ruckstell, president of Ruckstell-Burkhardt, Engineering Co., discussed light engines for auxiliary uses.

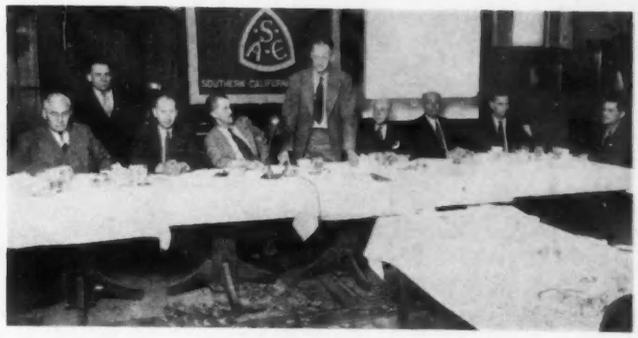
The aerial camera, described by Mr. Secor and commented on by Capt. W. A. F. Millinger, was conceived by Leon T. Eliel of Fairchild Aerial Surveys, Inc., and is designed for quantity production. It produces negatives 18 x 18 in., spaced about 5⅝ in. apart, continuously on a roll of film approximately 1000-ft long. The camera, it was explained, is entirely automatic and foolproof, being operated by an intervelometer, or manually, to take each negative singly or in a series of time-spaced photographs.

Southern California Section Meets in Three Cities

(Top) The Section's Governing Board takes a bow at the Los Angeles Fuels & Lubricants Meeting, Dec. 8. SAE President for 1939, William J. Davidson, second from right, was an unexpected visitor.

(Left) Standing room only at the Section's Aircraft Meeting held in Santa Monica, Dec. 15.

(Right) The speakers' table at El Centro, Nov. 17, when the Section repeated its Fall Transportation & Maintenance Meeting in that city.



According to the description, the camera is complete with indicators and instruments showing footage exposed, footage unexposed, cycle timing, number of pictures, and other necessary data. Signal lights show when film is metering, and when to punch film for developing in standard lengths. A red light flashes if anything is out of order or if the operator is not following instructions.

It was explained that provision is made for unloading any amount of exposed film or for loading the camera in daylight, and that, due to interlocking safety devices, it is impossible for anyone to fumble in unloading or loading in daylight and thereby ruin films and negatives.

The camera is supported on five regular type Lord shock absorbers, three in front and two in the rear; its weight being transmitted down through a universal joint to the wing plate, then through the shock absorbers to the airplane floor. Springs are used merely for lateral balance and to permit tilting the camera by means of a hand-operated toggle arrangement. Tip is obtained by raising or lowering the rear of the camera through a differential jackscrew.

Grunder, Emmons, and Willey Top F & L Program

● So. California

"The room reeked with oil," was one terse comment following the Southern California Section's fuels and lubricants meeting, Dec. 8. Dr. Ulric Bray was technical chairman and the speakers were Prof. A. O. Willey, Case School of Applied Science, who substituted for Dr. C. F. Prutton of the Lubri-Zol Corp.; Lawrence J. Grunder, of Richfield, and Claude E. Emmons, of The Texas Co. SAE President W. J. Davidson, in California on a business trip, was guest of honor. More than 350 members and guests attended.

The paper read by Prof. Willey on "EPness," as Dr. Bray called extreme-pressure characteristics, emphasized that gear lubricants must: (a) have load-carrying capacity adequate for all conditions to which it is subjected; and (b) it must have stability such that trouble will not develop from the long duration of service required in present-day operation.

Prof. Willey pointed out that adequate load-carrying capacity is not always easy to determine. Requirements differ, he said, for a set of gears subjected to excessive speeds and severe shock loads imposed by abnormal driving conditions, and for the gears and bearings of a transmission or axle when subjected to extremely high loads at low speeds for a long period of time. Yet, he added, the same lubricant might be called upon in each instance.

If the load-carrying capacity of the lubricant will not meet both of these conditions, failure will result, he continued, explaining that the first condition would immediately cause scoring of the gear teeth, and the second, after a longer period, would result in excessive wear and misalignment.

Prof. Willey said that in his opinion the development of separate lubricants determined by tests to be the best for each type of service would not be a practical solution. It cannot be expected, he declared, that each service station will stock four or more different types of lubricants and that the operator will properly diagnose the requirements of each vehicle he services as to which lubricant should be used in the rear axle, transmission, or overdrive unit. He believes that the satisfactory answer to the problem lies in the use of one of the so-called all-purpose types of lubricants.

Road Testing of Fuels

Improved methods for accurate comparative methods of road testing of motor fuels were described by Mr. Grunder, who revealed data and working charts developed in connection with tests carried on by Richfield.

Such tests are necessary, he said, because of the steady increase of "cracking" in the refining of fuels. He went on to explain that the road performance of highly cracked fuels differs from that of straight-run fuels of the same laboratory octane number.

While the most severe engine knock is attributed to full-throttle operation when maximum compression pressure and richest fuel mixture occur, Mr. Grunder said, more and more attention is being given to part-throttle knock which takes place at manifold vacuums between 8 in. and 2 in. of mercury, with leaner mixtures. Road tests have shown, he said, that as the ignition distributor wears this part-throttle knock increases to intensity nearly matching full-throttle knock, reaching its maximum at lower speeds.

Effect of Humidity on Knocking

Discussing the effect of humidity on the antiknock tendency of a fuel, the speaker said that dry air increases knocking and damp air suppresses it. Fuels used satisfactorily near the coast might knock severely in desert areas where the moisture content is low and the temperature high, he continued. Specifications that will meet these extreme conditions in localized areas are necessary, he declared.

The oil companies are probably closer to the motoring public than the car manufacturers themselves, Mr. Emmons said in his talk, noting that "as soon as he finishes with his installments, the car owner loses, to a considerable extent, the close contact that he had with the dealer and car manufacturer, and takes many of his troubles to his favorite service station operator or to headquarters."

Mr. Emmons told of the many changes in cars that have required changes and improvements in oil company products, and stressed the necessity of extremely close contacts between the service, research and technical forces of an oil company and the manufacturers of engines and the reciprocating parts of the car assembly.

Great Increase in Use Of Plastics Predicted

● **Milwaukee**

Although John Q. Public has been somewhat oversold on plastics through the medium of popular magazine and newspaper articles, there are tremendous future possibilities for products of these materials, the Milwaukee Section learned from H. S. Spencer, Durez Plastics & Chemicals Co., at its Dec. 15 meeting.

Mr. Spencer played the magician in pulling from his pockets a basket full of items which were made either in whole or in part of plastics. Developments in chemistry are going to increase the uses many times, he said.

There are five groups of plastics based upon the chemicals of which they are composed, the speaker explained. These combined with various fillers, such as wood flour, asbestos, paper, and textiles, give a range of physical properties for many applications. Many of these show beauty of color or a combination of colors which can be achieved in no other commercially practical way. He pointed out that plastics are used in commercial safety glass, and indicated that plastics will displace glass in many applications where weight reduction, flexibility, and special shaping justify the expense.

It was brought out in discussion that dies required for plastics usually run a little higher in cost than those for metals. In a few cases, it was said, this chemical material will be as low in cost as the die cast, but in general it will run about 20% higher; however, each problem has to be studied carefully to obtain any exact comparison.

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Rubber as Indispensable As Steel in Modern Cars

● **Indiana**

Rubber is no less indispensable than steel in the modern automobile, and without it our cars would become "jolt wagons," Walter C. Keys, of the U. S. Rubber Co., declared at the Dec. 14 meeting of the Indiana Section. Like steel, he added, rubber has become a structural, engineering material. We are coming to know the laws of rubber – what it will and will not do in all of its varied uses – yet in many cases we do not know the underlying why or wherefore, he stated.

In his informal discussion Mr. Keys demonstrated how we can predict just what to expect of mechanical rubber for almost any automotive use in which it is commonly employed. He also showed that there is much yet to be learned. In one demonstration he illustrated the advantages of rubber in vibration damping by suspending a weight by a steel spring which vibrated violently and bounced when dropped; suspended by a rubber band the vibration motions were slowed enormously. He also had equipment which showed that the life-span or durability of rubber is vastly greater when it is vibrated more or less constantly, than it would be if it were at rest constantly.

Mr. Keys paid special tribute to the accelerometer developed by Prof. H. M. Jacklin of Purdue University. He has used one in his laboratory, Mr. Keys said, since he first heard of it at the SAE International Automotive Engineering Congress at Chicago in 1933, and has found it as indispensable to his laboratory as mechanical rubber is to the modern automobile.

Names Factors Affecting Carburetor Efficiency

● **New England**

Fleet operators and others attending the New England Section's Jan. 9 meeting were told that it is a fundamental of good efficiency to make sure of motor tune-up and the mechanical condition of the engine, before tackling the carburetor, in a talk on carburetor maintenance and its effect on economy by W. F. Hagenloch, sales and service engineer of the Carter Carburetor Corp.

Carburetors, he explained, are designed to work under certain conditions and when these conditions are altered, operation of a perfectly adjusted carburetor is hampered. Poor economy results, he said, when air cleaners become dirty or collapse, and gasoline economy may suffer 10% or more when too great fuel-pump pressure raises the fuel level. Unless the manifold heat valve is operating properly the carburetor will not provide good performance, he continued, adding that if valve does not provide enough heat the performance will be flat, and if it provides too much, it will cause vapor lock and hard starting when the engine is hot in summer.

Coking up of carburetors, formation of hard carbon around the throttle valve in the bore of the carburetor, he stated, is caused by the oil breather pipes which run from the valve cover into the carburetor or air cleaner. The duty of these breathers, he explained, is to rid the crankcase of moisture and to prevent the formation of sludge. In doing this they also remove the light ends of the oil which in turn, by baking on the warm carburetor body, form carbon. Coking, he added, can also be caused by low-speed city operation as the continued idling allows the oil fumes to rise under the hood and be drawn through the carburetor.

Mr. Hagenloch then turned to the carburetor itself and with a series of slides illustrated the different types on the market and pointed out where maintenance can be used to increase mileage and help performance.

Equipment Credited for Cutting Highway Cost

● **Washington**

Reviewing the development of "Tools and Equipment for Earth Moving in Highway Construction," Col. Paul Weeks, Caterpillar Tractor Co., stated in his talk before the Washington Section's Dec. 12 meeting, that the past 20 years have produced developments in road-building equipment that are little less than marvelous. This, he said, has been attained through cooperation between the engineers, contractors, and equipment manufacturers. Future development, he insisted, will depend upon the continuance of this cooperation.

"Highway construction today," Col. Weeks noted, "requires the moving of six times as much earth per mile as did road building prior to 1919. The length of haul in earth moving has been increased. Entirely new methods and processes of placing and compacting fills have been developed to prevent settlement and to improve the supporting power for the foundation of pavements. Flatter slopes on the sides of both cuts and fills are now demanded to prevent erosion and to reduce maintenance cost."

How well equipment has kept up with these demands, Col. Weeks recounted, is indicated by the trends in the cost of excavation. Quoting figures compiled by the United States Bureau of Public Roads on the cost of excavation on Federal aid projects from 1922 to date, he stated, "these show a declining trend until the average unit price bid in 1938 was 45.7% of that bid in 1923. Inversely, the trend in wages paid for common labor on construction work was 47.4% higher in 1938 than the average for the years 1919-1923 inclusive."

Denver Club Meets

The Dec. 19 meeting of the SAE Club of Denver was held at the motorcoach garage of the Denver Tramway Co. Films were shown of trolley coaches and of the new President's Conference Car, one of the most modern of street cars. Talks were given by officials of the company and many of those attending examined the company's new buses.

See Proving Ground Pictures

When 40 members of the SAE Student Branch at the University of Michigan met on Nov. 9 they heard a short talk by Everett Farrell and saw moving pictures of tests being conducted at the General Motors Proving Ground.

Reviews Developments Increasing Air Safety

● Philadelphia

G. J. Hausamann, habitué of world airways and engineer associated with the Eclipse Aviation Division of Bendix Aviation Corp., was the principal speaker at the joint meeting of the SAE Philadelphia Section and the Aircrafters held on Jan. 10. Mr. Hausamann's talk on "Accessories and Flying Aids and Their Contribution to the Safety of Aviation" was leavened with colorful anecdotes of personal flying experiences; the accounts of his earliest adventures off the ground lending human emphasis to his recital of progress in aviation safety.

The Department of Commerce is adding considerably to its ground radio facilities and this work received immediate comment by Mr. Hausamann. He cited five phases of the Department's activity as especially outstanding. First, the installation of a large number of new radio-range-transmitters which, by being placed at closer intervals, are capable of giving more reliable service. Second, the change in the radio-range antenna system from the older loop type to the four or five-tower TL antenna system which reduces very appreciably what is known as "night" effect and its consequent troubles. Third, many new installations of the type which permit weather broadcasting to be conducted simultaneously with radio range transmission. Fourth, installation of a large number of positive cone-of-silence or "Z" marker transmitters which eliminate multiple cone of silence effects in broken terrain, and also installation of a few fan marker transmitters. Fifth, the extension of the traffic-control system by radio both along airways and at the airports themselves.

The speaker dealt next with the principal new devices, outside of government service, which are in operation or proposed. Anti-precipitation static antennas, taking the form of shielded loops, are now used almost entirely in the beacon band of 200 to 400 kc, he said, adding that this device reduces the hazard of losing the radio range course during conditions of precipitation static.

The radio compass or direction finder, Mr. Hausamann said, makes it possible for the pilot to triangulate and obtain his "fix" in flight, and also adds to the ease in which orientation problems can be solved. Considerable progress has been made toward the actual installations of various types of instrument landing systems, Mr. Hausamann noted, and progress has been made, too, he added, in the adaptation of ground-station direction-finding apparatus to be used for the purpose of checking the positions of planes in flight.

While radio has lightened immensely the burden of the overland flyer, said Mr. Hausamann, much has yet to be developed from the standpoint of the overseas navigator. Principally because of lack of sufficient range under all conditions of weather, he said, transoceanic operating lines have limited the use of radio navigation to a range of 500 miles or less. For greater distances, he explained, recourse is made to celestial navigation. Sensitive bubble horizons for use with the navigator's octant; new and quicker methods of calculating position with the assistance of semi-automatic calculation devices; and a sensitive altimeter, reading to within 15 ft, are among the developments of inestimable value to the navigator in computing his position mentioned by the speaker.

Mr. Hausamann explained that much has been done to simplify the instrument board and to reduce pilot fatigue by combining similar indications from several engines under one dial. Indirect lighting systems for instruments also have reduced eye fatigue. A particularly interesting development, noted the speaker, is the flight analyzer, an instrument which provides a continuous record of course and altitude and data, such as air speed and vertical acceleration. With this device records also can be made of the functioning of the automatic pilot, the use of de-icers, radio transmitters, and other accessories.

Accurate observation of weather conditions aloft, Mr. Hausamann said, is highly important, and within the past year a system of upper air surveys has been worked out. This, he explained, involves the use of a small radio transmitter attached to a balloon which ascends at a uniform rate of 200 meters per min to a critical pressure point in the stratosphere where the balloon bursts. During the ascent, the radio transmitter signals readings of temperature and humidity up to heights of 20 km or approximately 13 miles. On the ground a receiver linked with a recording instrument plots a chart with pressure levels as ordinates, and with temperature and humidity as abscissas, which is used for "upper-weather" analysis.

He referred to the Sperry automatic pilot as one of the best known developments in the direction of lessening pilot fatigue. High flying, he said, has introduced the need for an auxiliary oxygen supply and to this end the oxygen regulator, that feeds automatically an increasingly larger proportion of oxygen to the pilot as altitude increases, has been developed.

Among the aircraft powerplant accessories that contribute much to safety, Mr. Hausamann labeled the variable pitch constant speed, full feathering propeller as "probably the most spectacular." Several years ago, he said, ice forma-

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tion at the carburetor venturi was reported frequently as a source of engine failure. It has been found that by using a pressure type carburetor and by maintaining the temperature of the air at the entrance to the carburetor at approximately 100 F, ice formation in the carburetor can be practically eliminated, he noted.

Metal Parts Tested By Polarized Light

● **Cleveland**

Engineers are now able to "freeze" clues to potential weak points in machines and thus design safer metallic parts, it was revealed Jan. 15 before the Cleveland Section.

Dr. Miklos Hetenyi, research engineer of the Westinghouse Electric & Mfg. Co., described his new "freezing" technique as 3-dimensional photoelasticity, because it measures stresses applied in all directions. He told how he utilizes polarized light to determine even the distribution of centrifugal stresses in such large rotating units as the shafts of motors and generators which may weigh several tons and revolve more than 3600 times a minute.

Dr. Hetenyi stated that the investigator need never see the metal part he is investigating as he uses only a transparent "heat hardening" bakelite model of the part. Placing this test piece in an electric oven, he loads it proportionately to the load the full-sized part must withstand, then turns on the heat. For an hour the model "cooks" at approximately 240 F, and when it cools to room temperature its elastic deformation is solidified. It remains permanently deformed even when its load is removed. The stresses are frozen solid.

The investigator carefully cuts a slice through the model, Dr. Hetenyi continued, and places this segment in a polariscope, an apparatus resembling a giant magic lantern. Polarized light, which vibrates in only one plane instead of scattering like ordinary light, is then passed through the bakelite slice. When the light rays come out the other side of the test piece they are captured by the so-called analyzer and form a picture of the stress lines in the model.

By studying these lines or stress fringes of variegated colors, Dr. Hetenyi explained, the engineer can see exactly where the greatest stresses will occur in the machine part which he is designing. The picture, he noted, is an accurate map of stress distribution. In the past the designer has had no accurate way of knowing what this distribution might be in complicated parts of varying thickness and loading. His only recourse has been to attempt to arbitrarily make the part larger and stronger than necessary in order to provide a factor of safety.

Various machine parts, shafts containing keyways and circular holes through their center, and motor rotors have now been successfully analyzed for stresses by this new method, Dr. Hetenyi reported. In the case of the rotor a model was whirled at a constant speed inside the electric oven and cooled until its elastic deformation was solidified. A thin slice of the deformed model revealed the stress distribution when it was examined under polarized light.

Actually a solidified elastic deformation is a contradiction, the research man pointed out. By its very name, an elastic deformation is one which recovers as soon as the deforming force is removed, but a peculiar dual personality in the molecular structure of bakelite makes possible the paradox of a permanent elastic deformation. Dr. Hetenyi explained:

"Investigations have shown that the structure of bakelite consists of a strong primary network of molecules branching off in all directions and serving as a skeleton for the bulk of the material. This network has high mechanical strength and is in an infusible condition. However, its cells are filled with a material which is in a fusible condition, though chemically the same.

"While this fusible material is solid at room temperature, its viscosity decreases rapidly when the temperature is raised, and it begins to flow. It becomes liquid at around 230 F, at which point the strong primary molecular network of a bakelite model under test carries all of the load and is deformed elastically. If the load is left on the test piece and the temperature lowered, the deformations will remain the same. The only change will be in the fusible part inside the cells, which returns to a solid state. With its large mass this fusible part surrounds the stressed and deformed elastic skeleton and keeps it permanently in that condition even when the load is removed."

74-Passenger Clippers Soon to Be in Service

● **Washington**

Clippers carrying 74 passengers and a cargo 5000 lb soon will be put into European service by Pan American Airways, Lowell W. Lee, district sales manager of that company, revealed to 225 members and guests attending the Jan. 9 meeting of the Washington Section. These new ships, he continued, will have a gross weight of 82,500 lb and will be powered by four Wright "Cyclone" radial double-row 14-cyl air-cooled engines, each rated at 1500 hp.

A spectacular colored moving picture "took" the Washington Section on a complete Pan American flight from Alameda, Calif., to Hong Kong, China.

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QUIET

1940 SAE Annual Meeting

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noon," he declared pompously, "we have developed an apparatus that cuts right through this utter confusion; we offer it to anyone who wants to use it." He then displayed a crystal ball!

Questions were next directed at Mr. Eisinger and Mr. Mount by Gilbert Way, Ethyl Gasoline Corp., at this point. In reply Mr. Mount told him that the apparatus described in the paper read by him will catch knock that the ear cannot pick up. Mr. Eisinger explained that all the cars used in the tests reported by Mr. Duckworth had six cylinders.

We must not let the so-called confusion be the cause of throwing up the sponge, exhorted Dr. U. B. Bray, Alox Corp., referring particularly to that existing as to the influence of carbon deposits. He pointed out that credit should be given to the work of Bartholomew of Ethyl Gasoline Corp., which "led to the concept that one of the biggest ways to improve lubricating oils was to develop one that would minimize carbon deposits." If we can make oils that have a minimum of oil deposition, he concluded, we will reduce the confusion.

Mr. Gibson noted excellent agreement with Dr. Becker's 90% point, recalling that their results came out at 93%.

Chairman Holaday concluded the meeting by reading the 1940 Cooperative Road-Test Program. Because of the number of different methods of getting road knock ratings, the report pointed out, it is almost imperative that the Motor Fuels Division re-examine the present CFR Road-Test Procedure and study the relationship between fuels, cars, and driving conditions. Therefore, the Motor Fuels Division has adopted a program of cooperative tests which consists of two parts: 1. Exchange road tests by cooperating laboratories. 2. Centralized cooperative road tests. Methods of test were then outlined.

C.F.R. Motor Survey Report, 1939 – DONALD B. BROOKS, National Bureau of Standards. (Presented by Clarence S. Bruce of the Bureau)

IN 1936, Mr. Brooks reported, the Cooperative Fuel Research Committee initiated an annual survey to determine the fuel quality requirements of modern automobiles with respect to vapor lock and knock.

The fourth annual report of this survey, prepared by the National Bureau of Standards, he said, shows that the octane number of fuel required to operate 1939 automobiles without knock is slightly higher than that found for 1938 cars. Many cars as run on the road require a higher grade of fuel to suppress knock because of improper adjustment of the spark advance mechanism, he reported. In 2 cases out of 3, he noted, readjustment reduced the fuel requirement by about the difference between premium and regular grade gasoline, and scraping carbon made an even greater difference in 9 cases out of 10.

Half of the 1939 automobiles tested, said Mr. Brooks, would operate satisfactorily on regular grade gasoline, but a small percentage would knock even on premium fuel. In regard to vapor lock, he stated, half of these cars would operate satisfactorily at an air temperature of 100 F on a gasoline having a Reid vapor pressure of 9 lb per sq in. One in eight, however, would require an 8-lb fuel, and one in twenty a 7-lb gasoline.

Gasoline, Cars and Surveys – J. B. MACAULEY, JR., Chrysler Corp.

DURING the last four years, Mr. Macauley stated, the Cooperative Fuel Research Committee has sponsored two surveys – the CFR Motor-Gasoline Survey issued semi-annually by the United States Bureau of Mines, and the CFR Motor Survey, issued by the Cooperative Fuel Research Committee directly. The CFR Motor-Gasoline Survey, he explained, was requested by the automobile industry and consists of data relative to gasoline properties found to exist throughout the United States during a certain period. The CFR Motor Survey, Mr. Macauley continued, was requested by the petroleum industry and consists of data relative to the fuel requirements of automobiles at various intervals. These surveys, he stated, represents a great amount of work – so great in fact that it is only practical when there are a number of cooperating laboratories submitting data. He then showed how the information contained in these surveys is useful to both the petroleum and automobile industries and how it should assist in making progress in the joint car-fuel problem.

Discussion

The papers by Messrs. Brooks and Macauley were not controversial, and were not discussed as such. C. W. McKinley, AC Spark Plug, recounted some experiences with vapor lock. He questioned the economic value of high-vapor-pressure gasoline, commenting that on a hot summer day it is not unusual for vapor pressure to drop from 11 to 8 lb per sq in. If the high vapor pressure could be kept, it would be economical, he contended, but said it is hardly worth providing if it goes out of the gasoline tank's vent hole.

To a large extent, Mr. McKinley continued, the problem of pumping high-vapor-pressure gasoline has been overcome. The remaining problem is to get the gasoline through the carburetor as the vapor in the gasoline is sufficient to block its flow. When we can develop a carburetor to take it, he declared, we will go a long way toward getting rid of the vapor-lock problem.

The Load-Carrying Capacity of Journal Bearings – S. A. McKEE, National Bureau of Standards.

ALTHOUGH research of inestimable value has provided a reasonable working knowledge of the hydrodynamics of the load-carrying film, this information in itself cannot answer the question so pertinent to the engineer: "How much load can this bearing safely carry when operating at a given speed with a given lubricant?" Mr. McKee contended.

The purpose of his paper, he announced, is to indicate how heat-dissipation data, together with the existing knowledge of the hydrodynamics of the oil film, may be used to provide, with some degree of accuracy at least, an answer to this question and also to estimate the effects on the load-carrying capacity of the bearing of changes in a number of the various factors involved in journal-bearing lubrication.

Mr. McKee first obtained the range of loads and speeds for safe operation with a given oil and bearing, and defined bearing temperature as a function of load and speed. He then determined the effect on the limits of safe operation of change in (1) viscosity or viscosity index; (2) ambient temperature (that is, summer or winter operation); (3) limiting ZN/P (due either to oiliness or kind of bearing material); and (4) heat-dissipation characteristics of the system. He reported that the heat-dissipation characteristics can produce many times the maximum effect produced by any of the other three. His analysis also showed that the permissible load always decreases with increase in speed above some quite low value of speed and has other interesting consequences.

Discussion

The $\frac{ZN}{P}$ curve took the spotlight in the comment following Mr. McKee's paper. Prof. H. A. Everett, Pennsylvania State College, referred to it as a gadget that appears sound but turns out to be rotten upon close examination. It assumes, he said, that Z, the viscosity, remains constant, whereas this is not the case as it is affected by temperature and pressure. The value Z becomes pseudo viscosity, he added.

Prof. Everett pointed out that rising bearing temperature decreases viscosity and that increasing pressure builds it. Thus, he said, the viscosity of the oil on the bearings is varied.

Mr. McKee noted that the relation of change of viscosity to pressure is not too well known, suggesting that the method of attack in determining it would be to run experimental work and study effect of change of viscosity with pressure.

The effect of pressure on viscosity is of real scientific interest, said Oscar C. Bridgeman, National Bureau of Standards. He pointed out, however, that it may not be of as much importance as the effect of temperature. He pointed out that much more can be done to increase the load-carrying capacity of a bearing by changing the temperature of the bearing than any other thing. This was borne out by Chairman Marshall, who told of success with oil-cooling radiators.

Others entering the discussion were Dr. H. C. Dickinson, National Bureau of Standards; A. W. Pope, Jr., Waukesha Motor Co.; and J. M. Roth, Pump Engineering Service Corp.